ELECTRONICS Australia

HIFI NEWS

APRIL 1974
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NEW KODAK MOVIE CAMERA MAKES TALKIES

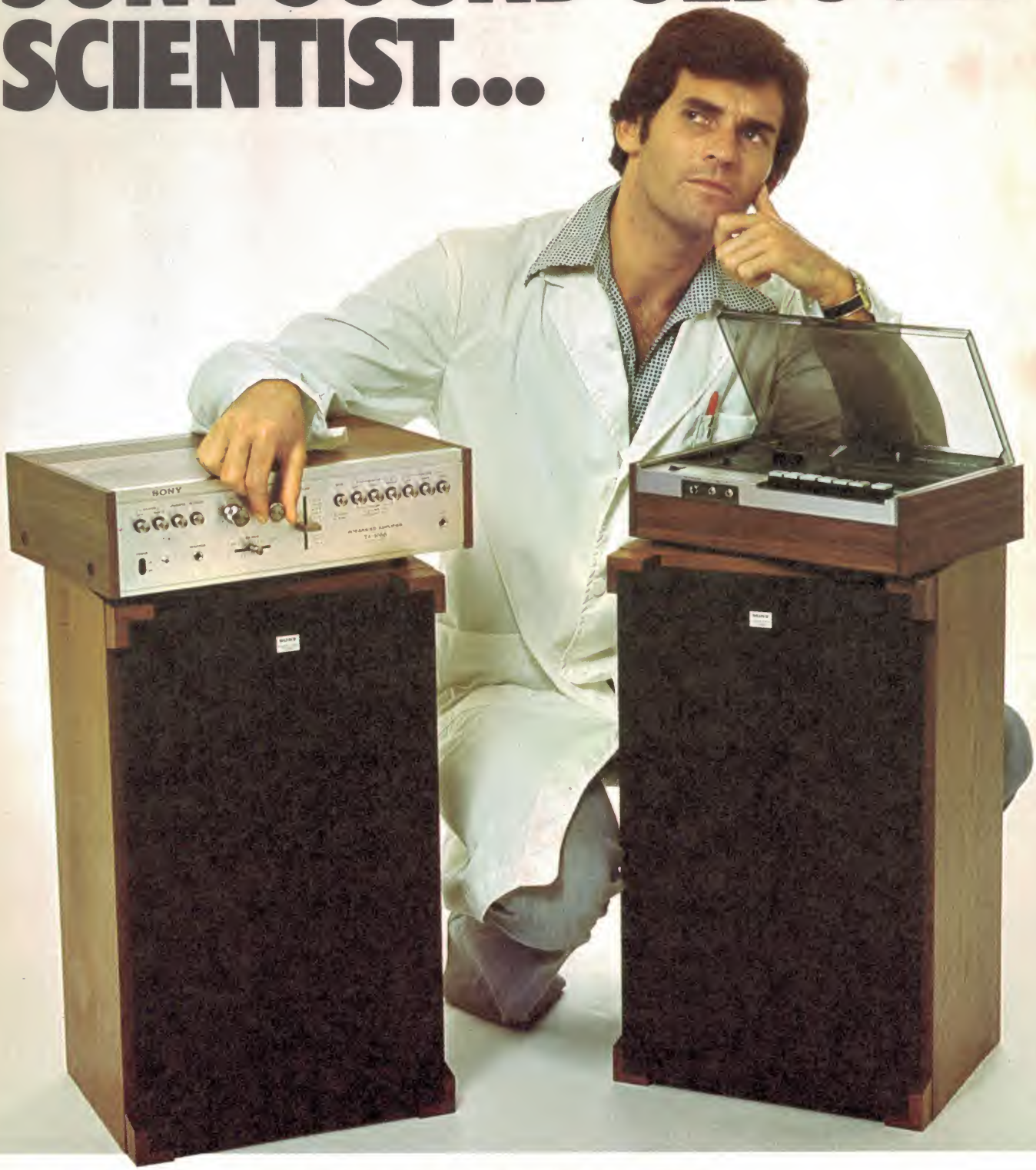
GERMAN EXPERT COMMENTS ON OUR FM CONTROVERSY

JUST HOW SAFE ARE ATOMIC POWER STATIONS?

FEATURE PROJECT: TEST YOUR REACTION TIME

LOW COST CONTROL UNIT FOR MODEL TRAINS

SONY SOUND SEDUCES SCIENTIST...



The man in the white coat is a sound specialist. And he has just been captured by Sony. He's puzzling how such quality sound can come from such a compact, low-priced system. It's Sony's newest combination — the feature-packed Sony integrated amplifier model TA-1066. It has direct coupled differential power amplifier, a balanced positive and negative power supplied equalizer amplifier, and true complimentary circuits. Styling is the latest, with push button controls. Inputs and outputs for 2 tape decks permit dubbing between the deck and simultaneous recording. Slide volume balance has centre click adjustment. Frequency response is 10 Hz-40kHz and it cruises at 15W RMS per channel.

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ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 36 No 1

With this new super-8 movie camera, amateurs can now make professional "lip-sync" talkies easily and at moderate cost. See page 26 . . .

Probably the star witness at the recent FM inquiry was Dr Lothar Rohde, known in Europe as the "father of FM", who also gave E-A an exclusive interview. Read about his views in HiFi News, on page 11.

On the cover

A model shows the new Kodak "Ektasound 140" super-8 movie camera, which records sounds simultaneously with picture-taking. It uses pre-striped film in a modified drop-in camera cartridge, and includes a complete solid state magnetic recording amplifier with audio AGC system. (Courtesy Kodak Australasia Pty Ltd).

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Now Philips add a full editing model to their range of Video Cassette Recorders

The Philips VCR (Video Cassette Recorder) format can now give you even greater video production flexibility. The new N1520 is designed for use with any video camera and permits perfectly clean electronic edits. You can edit recordings of colour and monochrome material and playback through any standard TV receiver. And the N1520 is fully compatible with Australia's PAL colour TV transmission system.

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Electronic editing allows the error-free adding of a new recording (picture or sound) to an existing recording or merely the insertion of a new picture to existing sound. There are two separate sound tracks–each allows independent dubbing onto recorded programmes.

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PHILIPS

Editorial Viewpoint

A pocket-sized revolution

Only ten years ago, digital voltmeters were costly and exotic gadgets found almost exclusively in the rarified air of research and standards laboratories. And computers were large and immobile monsters housed in air-conditioned complexes, consuming vast stacks of punch cards and many kilowatts of power. Any suggestion that both of these important artifacts would become available as pocketable, battery operated devices within a decade would have been treated as pure science fiction.

Yet that is exactly what has happened. The other day I held pocket versions of both these devices in my hands, and if ever I needed a dramatic demonstration of the way in which electronic technology is accelerating, they certainly provided it.

The devices in question were both from Hewlett-Packard, shown to us by HP's manager for the Northern states, Harold Norrie. One was the HP model 907A probe multimeter, which was featured in our October 1973 issue; the other was their new HP-65 programmable calculator. With no less than 51 hardwired keyboard functions and the ability to be programmed using tiny magnetic cards, the latter is virtually a complete pocket-sized computer.

There's no doubt about it, modern electronics has made incredible advances. Devices like these are so far removed from our early attempts at measurement and computation that even someone like myself working daily in the technical side of electronics cannot fail to be moved when confronted with them at first hand.

Many of my friends who know little about electronics say they envy me, working in a field where so many exciting developments are taking place. I suspect that they say this because they believe that those of us "inside" electronics are capable of assimilating all of the new developments, and of course this is quite wrong. The time has long since passed when any one person could know and understand all of the vast body of knowledge lumped together as electronics. The ever-accelerating pace renders most training obsolete in a very short time, so that even those who are pioneering new frontiers are almost as laymen in most areas other than their own specialty.

And yet my friends are right. Electronics may be frustrating in its diversity, awing in its complexity, even downright depressing when it is seen to be accelerating so fast away from one's puny knowledge; but it certainly isn't boring.

Electronics is undoubtedly passing through an exciting era, and I for one feel privileged to be able to share in a small part of the excitement.

—Jamieson Rowe

EDITOR-IN-CHIEF
Neville Williams
M.I.R.E.E. (Aust.) (VK2XV).

EDITOR
Jamieson Rowe
B.A. (Sydney), B.Sc. (Technology, NSW)
M.I.R.E.E. (Aust.) (VK2ZLO / T)

ASSISTANT EDITOR
Philip Watson
A.M.I.R.E.E. (Aust.) (VK2ZPW)

EDITORIAL STAFF
David Edwards, B.E. (Hons, Tasmania).
Ian Pogson (VK2AZN / T)
Leo Simpson
Greg Swain, B.Sc. (Hons, Sydney)
Ross Tester

GRAPHICS
Robert Flynn
Greg Barlow

ADVERTISING MANAGER
Selwyn Sayers

CIRCULATION MANAGER
Alan Parker

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Editorial Office
12th Floor, 235 — 243 Jones Street, Broadway, Sydney, 2007 Phone 2 0944.
Postal Address: PO Box 157, Beaconsfield 2014.

Advertising Offices
Sydney — 57-59 Regent St, Sydney 2008. Phone 699 3622.
Representative: Graham Gawne.
Melbourne — 374 Little Collins Street, Melbourne, 3000. Phone 67 7021.
Representative: Jeffrey Byrne.
Adelaide — Charles F. Brown & Associates Ltd, 429 Pulteney Street, Adelaide, 5000. Representative: Tom Duffy 23 1657.
Perth — 454 Murray Street, Perth, 6000. Representative: Jack Hansen. 21 8217.

Subscriptions
Subscription Dept, 21 Morley Ave, Rosebery, NSW. Phone 663 3911.

Circulation Office
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SPEAKER SYSTEMS IN KIT FORM

All Instrol speaker system kits come complete with veneered enclosure kits, innerbond acoustic wadding, grille cloth, speakers, crossover networks, wiring, etc.

WHARFEDALE SPEAKER SYSTEM KITS

The Wharfedale Super Linton, Melton and Dovedale 111 are now available as build-yourself kits, featuring INSTROL quality cabinet kits.
The Super Linton kit employs an 8" and 3" speaker, frequency response 40-17KHz, cabinet 21" x 11½" x 9½". 15 watts RMS. Available in Walnut, Teak or Maple veneer.
The Melton kit employs a 12" bass and a tweeter, cabinet 22¾" x 13" x 10". 25 watts RMS. Available in Maple veneer only. The Dovedale 111 kit employs a 12" bass, 5" mid range and 1" tweeter. Cabinet 28" x 15½" x 10". 35 watts RMS (Teak or Walnut veneer).

Super Linton kit (Unit 3) (normally $55)	$42.00
Melton kit (Unit 4) (normally $99)	$79.00
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All prices quoted are for fully inclusive speaker kit complete (per side).

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Featured in "E.A." Jan. 1971, it handles 30 watts RMS, complete with high performance 8" speaker, two 3" tweeters, available in cabinet 20⅞" x 12⅞" x 8⅞" (1 cu. ft.) or 23⅞" x 15½" x 10⅞" (1.6 cu. ft.). All prices quoted are per side, for fully inclusive speaker kits complete (choice of Teak or Walnut veneer).

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10 / SL	27¼ x 17¼ x 7	10" (distr. port)	teak	$14.95
BK / SH	19¼ x 11½ x 6⅛	6" + 5"	maple	$10.95
8 / DP	23½ x 10¾ x 9	8" (distr. port)	teak	$15.95
12 / DP	30 x 18 x 12	12" (distr. port)	teak	$27.95
12DP-3	30 x 18 x 12	12" + 3" (d.p.)	walnut	$27.95
8 / VE	27¼ x 17⅞ x 10	8" (vented)	teak, walnut	$21.95
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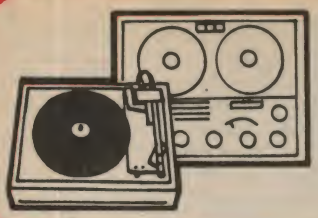

Hi Fi News

Strong support for FM on VHF

"FM on UHF? You're mad!" That was how Dr Lothar Rohde, partner in the large West German electronics company Rohde and Schwarz, reacted to the proposition put forward by the Australian Broadcasting Control Board, and ratified by the last Parliament. Dr Rohde felt so strongly about the subject that he flew out to Australia especially for the recent FM Inquiry.

by NEVILLE WILLIAMS

At the Inquiry, Dr Rohde's evidence contradicted that of the Control Board's engineers and probably paralleled the (as yet) privately held views of the Inquiry Chairman, Sir Francis McLean. Observers expressed the view that the submission drove the final nail in the UHF coffin and made it inevitable that the authorities find a way, somehow, to provide an FM service within the limits of the usual 88-108MHz band.

Supporters of the VHF service went home feeling that they had seen the tide of battle turn in their favour, which must have been a new experience after nearly twenty years of reverses. But whether they will win the war, — or how soon — yet remains to be seen!

One thing is certain: the attention which has been focussed on the electronics industry, firstly by the tariff question, and now by the FM Inquiry, has greatly weakened the industry bloc which supported the status quo of 1972. Having been widely and loudly accused of predominantly commercial motivation, the bloc will be at a severe disadvantage in trying to sustain the technical and organisational merits of their case.

They may even "give it away".

The Control Board itself has undergone profound changes and, as at present constituted, may be more willing to go along with the views of men like Dr Rohde and less inclined to defend its earlier recommendations.

To quote The Australian Financial Review: "The new-look Broadcasting Control Board is a very different body under the present Labor Government to what it has been under past administrations. Appointees in the past . . . have generally been career Government servants (often with a technical background) or academics.

"With the departure of Mr Donavan has gone the last career Government servant from Control Board membership."

Dr Rohde's interest in the subject of FM broadcasting dates from way back. He constructed the first FM transmitter to operate in Europe, actually for the German broadcasting system. He was closely associated with the development of the technique and was created an honorary Doctor of Engineering by the Munich University in recognition of his services to the German FM broadcasting system.

More recently, he was seconded to plan a complete FM and TV service for South Africa, utilising the VHF spectrum. His role for this assignment bore some comparison with that of Sir Francis McLean, except that Dr Rohde's concern was with initial planning, rather than re-planning.

The FM service in South Africa is now operating, and television will begin, in colour, in 1975.

Following his submission to the Inquiry, Dr Rohde spent a substantial part of a morning with the editors of "Electronics Australia" and "Electronics News," chatting informally about FM broadcasting as it might be implemented in Australia.

He was adamant that Australia could have an FM service on VHF "if you really want it." How comprehensive that service would depend on what adjustments we were prepared to make over a period of time.

Questioned about his pioneering role, relative to that of the late Edwin Armstrong, Dr Rohde said that Armstrong must be credited with having invented the FM system, along with such other things as the superheterodyne and the super-regenerative detector. However, while FM originated in America, the technological refinement came mainly from Europe.

Nowadays, the continent is spanned by a multiplicity of high quality FM services, and FM is very much a part of the European way of life.

Dr Rohde said that, professionally and commercially, his interests were divided between instrumentation, for which his company is famous, and the manufacture of telecommunications equipment. His company was active in both the VHF and the UHF spectrum and commercially: "VHF, UHF, what's the difference? We can supply both!"

Pressed further, he said that he had a deep personal interest in FM broadcasting and good sound reproduction, quite apart from his professional involvements. It was really this personal interest which had kept him close to the FM / stereo scene over a very long period of time. He was keen on stereo but had severe reservations about quadraphonic — at least from his own viewpoint as an active musician.

Expanding on his earlier FM submission, Dr Rohde said that the Board and its engineers had been thorough in doing their homework but he felt that, at a practical level, interference problems would not be anything like as severe as theory would seem to predict:

"There is usually a way around these things. After all, if you try hard enough, you can prove almost anything is impossible!"

And this "practical" philosophy seemed very largely to sum up Dr Rohde's evaluation of the Australian situation. If we want FM, we can have it, and put to use the very large number of FM tuners which have already found their way into the country, as part of both hifi and portable receivers.

To be sure, there would be problems, and we might need ultimately to shift a couple of

Dr Lothar Rohde (left) explains some of the points he made to the recent FM Inquiry to EA, Editor-in-Chief Neville Williams. Dr Rohde said that, while an FM service should be possible on VHF in Australia, German authorities had all along been more meticulous in legislating against the potential interference situations which Australia might have to face.

There's more to mid-range frequencies than meets the ear.

The graphic illustration below represents the typical frequency response expected in a good hi-fi system. A large proportion of the sound can be classified as mid-range and to hear this sound at its best a well engineered mid-range speaker is essential.

The new Plessey C6MR has been specifically designed to handle mid-range sound with excellent performance from 450 Hz to 6600 Hz and sharp roll off beyond these frequencies.

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Voice coil impedance
8 or 15 ohms
Power Handling 20 watts RMS with recommended crossover
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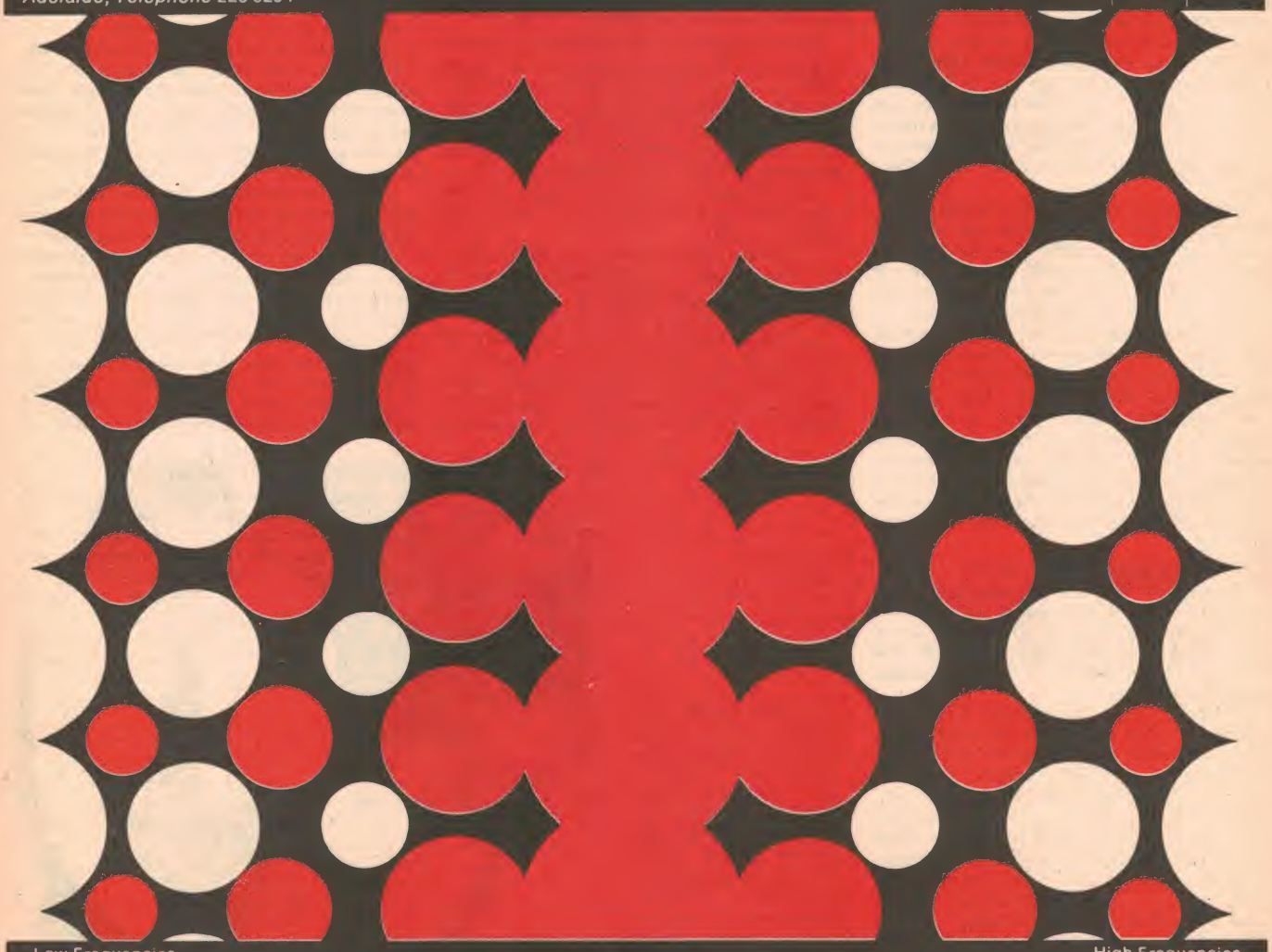

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AR60

TV channels, but these things are not insuperable. Almost certainly we would need to upgrade our requirements about spurious responses and radiations from receivers in particular. In fact, minimal spurious radiation was virtually taken for granted in Germany and no receiver could be marketed without having been granted a clean bill of health!

Listening to the Doctor, it seemed that the whole emphasis of his submissions to the Board, and the whole weight of the subsequent questioning had been on the technical practicability of fitting a reasonable number of FM transmitters into the VHF spectrum, intermixed with television services.

He was quite surprised when we raised the question of how such a service would most likely be utilised. Would it be likely to gravitate towards "fine music" or pops? Would the emphasis be on program content or freedom from electrical and atmospheric interference? Could enough channels be found to satisfy the demand for public access or minority groups?Is it not likely that some of the groups which have supported

Australia could have an FM service on VHF if you really want it.

These are political questions which your government must answer.

VHF FM collectively, will end up by being disillusioned individually?

"These are political questions," said the Doctor.

But, as we talked, the importance of such questions became patently apparent.

In Germany, the FM channels do carry advertising, but in compact and scheduled blocks. There is not the pressure to win ratings by pushing standards downwards. Rather is there opportunity to cultivate and maintain an appreciation for better music.

In the United States, on the other hand, there has been a gradual drift of FM programming away from the cultural to the popular level. At the same time, dedicated groups did maintain individual stations in some of the main cities, which served their special interests.

Cassette Format Has Reached Maturity

The cassette format is coming of age in "2dB steps", small in themselves but adding up to an impressive total. It's no longer a question of whether cassettes will be accepted. It's a matter of the speed and direction of the process.

As little as four years ago, our April 1970 issue carried only one small advertisement for a stereo cassette deck — a TEAC A20. It was offered by Convoy Technocentre as "the first and only semi-professional HiFi compact cassette, tape play-record deck." The advert continued: "Practically no one has one of these yet. Be a pace setter with a TEAC A-20."

Twelve months later, in April '71, there were two advertisements in our issue, the TEAC A-22 and Akai CS-50.

These are not statistics by any means but they do indicate that the marketing of hifi stereo cassette decks in Australia, at the time, was still a very low-key operation. They were struggling for recognition against reel tape machines (Perhaps I should have typed "real" tape) and both were completely overshadowed by stereo discs.

Since then, hifi cassette players have come on strongly in Australia in particular, where they have suffered minimal competition from tape cartridges. Hifi stores are currently bulging with cassette players and pre-recorded tapes and we are rapidly reaching the stage where every hifi system has to include one, if only to keep up with the Jones's!

The choice of a cassette player has tended to be a somewhat more traumatic experience for the informed enthusiast than it has been for others, mainly because he has been aware of pressures within the industry favouring this technique or that. What tends to be merely technical jargon to the public is seen by the enthusiast as something which may or may not limit the usefulness of a particular deck in the futute.

Mention "Dolby", "ANS", "CRO tape" or "bias level" to a non-technical prospect and you'll see what I mean. They can be talked into, or out of, any of these facilities, singly or collectively, according to the inclination of the salesman and the capacity of their cheque book. What they respond to is whether the item they fancy looks well, works well and sounds well here and now, jargon notwithstanding.

The informed enthusiast is much more hesitant. He knows, for example, that chromium dioxide tape may become established as the "ultimate" for home recording, or it may be swamped by high performance ferric tapes; but if CRO tape achieves its premium position, its advantages will be realisable only on decks designed to take it. Whether or not to buy a CRO facility is a significant decision.

Again, "Dolby" is more than a piece of jargon. If it becomes standard practice to release "Dolbyised" pre-recorded tapes, then only a Dolby deck will reproduce them with the intended dynamic range. But if pre-recorded tapes are not Dolbyised, and improving tape formulation banishes ob-

(Continued overleaf)

The pressures which might operate on an FM service in Australia could be somewhere in between the two, and may mirror the program pattern of the existing AM service if it is not inhibited in some way.

Dr Rohde thought it possible that FM, with its superior quality, might educate listeners to expect better music from the radio. But then, they might expect — and get — hifi stereo pop!

Hard on the heels of Dr Rohde's appearance before the FM Inquiry, the Broadcasting Control Board released a report to the Minister for the Media, Senator D. McLelland, indicating that it would be practical to restructure the existing AM broadcasting system to greatly increase the number of stations, and accommodate some of the local minority interests. The scheme would involve greater use of directional transmitting aerials and increased power for established commercial and ABC stations.

The report was seen by the non-technical Press as an about-face by the Board. In some ways it was, but the reaction of the Board — and the Minister — is more likely to have been in anticipation of the recommendations of the Committee of Inquiry under Sir Francis McLean.

Assuming that the Committee recommends utilisation of the VHF band for FM services, its introduction would, of necessity, be fairly slow.

The proposition would have to be examined and a firm plan prepared to show what frequencies and powers would be available initially; whether any television allocations would have to be altered, at what cost and when; also the possible wider use of television channel 11.

Flowing from the number of channels, an entirely separate hearing would have to determine the type and identity of the licence holders, who would only then be able to take steps to establish their stations.

My tip is that, having seen the VHF "writing on the wall," the Minister and Board are pretty sure that there will not be enough channels on VHF to provide a basic broadcasting service as well as accommodating the many other aspirants for local licences. The idea of allocating them low power licences on the medium wave band is one way out of the difficulty.

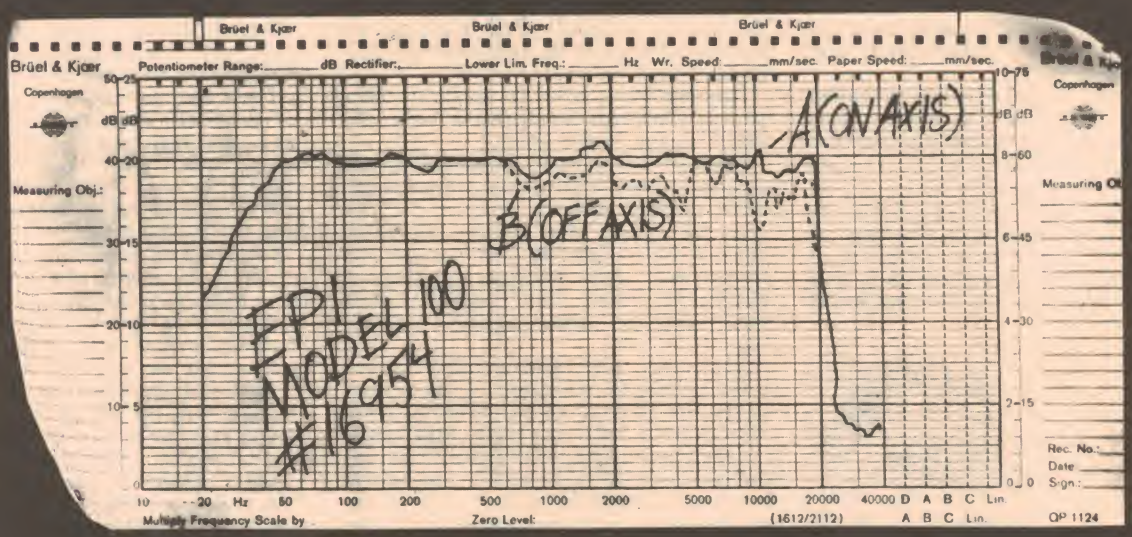
In short, an alternative to accommodating everyone on the wide open spaces of the UHF band is to accommodate the major stations on VHF FM and as many others as possible on low power medium-wave AM.

Whether this is what the minority groups would like is another matter. So also is Government policy on minority groups — and the whole question of how big is a minority?

Undoubtedly, the FM story hit some sort of a climax with the appearance of Dr Rohde, but there are quite a few more episodes yet to go in the FM saga!

EPI ARE VERY PROUD OF THEIR MODEL 100

So proud in fact that they pack an individual frequency response graph with each speaker as proof of its superb performance.



This is wnat the frequency response graph looks like

Everybody talks about linear response.

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vious problems with noise and frequency response, then Dolby and CRO facilities would become luxuries, seldom missed.

And what about "glass heads", "ferrite heads", "twin capstans" and so on. Are they just part of the jargon, or are they technically significant?

The "2dB steps" we referred to earlier, and the maturing of the cassette format, are seen in the gradual rationalisation and merging of attitudes throughout the industry and the substitution of fact for emotion. It is now possible to take a more definite attitude in the contentious areas, even though there is still room for argument in a few of them.

It may be a helpful exercise to nominate and comment upon a variety of aspects which have represented the hang-ups about cassettes, and which are slowly being resolved.

CASSETTES V OPEN REEL: There can be no argument that open reel tape has the potential for higher performance figures. However, tremendous development of the cassette format has produced equipment and tape which can meet most high fidelity user requirements. This, along with its convenience and its ready extension to in-car and outdoor usage, has pushed the cassette into a dominant position in the tape market, both for home recording and prerecorded entertainment. There is some speculation that cassette technology may ultimately foster the release of more prerecorded open reel material but this is still speculation. For tape in the home, cassette equipment is now quite definitely the thing to go for, unless you have a specific reason for selecting open reel.

CASSETTE V CARTRIDGE: Developed somewhat ahead of cassettes, the cartridge format gained a strong advantage in the automotive market, for which its 8-track, continuous play feature makes it particularly suitable. At the same time, the problems of fast spooling make it much less attractive as a general purpose tape facility. As a result, there has not been a great deal of pressure to refine the cartridge format beyond the modest needs of an automotive music source. Its ready adaptability to discrete 4-channel recording will inevitably inspire up-grading of the system as a whole but, in the general hifi field, cartridges have lost an advantage, which may never be regained.

CASSETTE MECHANICS: There has been a significant amount of trouble with cassette tape squealing, breaking, jamming or winding itself around the capstan. While there has been a tendency to blame this on "cheap" cassettes, the prestige brands have not been without their problems. However, these are short-term rather than chronic and it is reasonable to expect that experience will weed out those cassette construction methods which have proved troublesome, either intrinsically or with certain types of playing deck. Given some discretion in choosing cassettes which work well with a particular deck, it is now reasonable to expect incident-free operation. Perhaps it is appropriate to add that all tape systems have had their share of spooling, breakage and spillage problems.

DECK MECHANICS: In general terms, the current generation of hifi cassette decks will meet normal expectations in terms of control facilities, spooling, freedom from wow and flutter, etc. However, cassettes must be considered as part of the total mechanism and some cassettes may work marginally better with a particular deck than others, mechanically and/or electrically. Some effort to establish compatibility is worthwhile. One of the newer facilities well worth having is automatic shut-off, which will remove the drive at the end of tape traverse in either direction and for any mode.

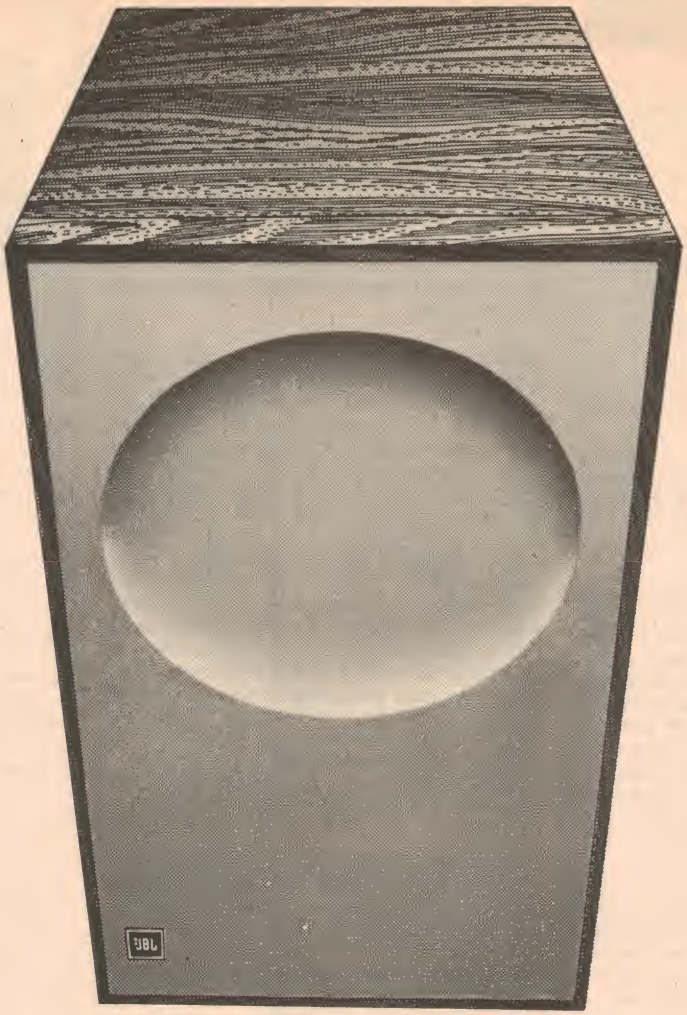
DECK ELECTRONICS: In all tape systems, the ultimate electrical performance depends on the amplifier and bias circuitry, the magnetic properties of the tape, and the degree to which each suits the other. These factors become particularly critical with the cassette system because, with the slow traverse speed and the narrow tracks, everything has to be just right. While providing good quality head, and a good amplifier design, the manufacturer still has to set the supersonic bias to a level which will suit typical good quality tape. But no one setting can be absolutely optimum for each type and brand of cassette. The user may therefore notice marginal differences in the quality from particular types of cassette and these observations, along with the mechanical considerations already mentioned, will guide the choice of tape for your particular deck.

"BARGAIN" CASSETTES: Initially, these tended to put people off the cassette system because of their mechanical and electrical limitations. However, they did have the very useful effect of forcing recognised manufacturers to cater for the economy market. Nowadays, cassette buyers have come to expect — and receive — what they pay for, which is the way it should be. If a particular cassette will meet the user's need at half the price, it may well be a bargain. In fact, the ability to make a casual recording at minimal cost is one of the attractions of the system. Incidentally, a cassette which is screwed together is often a better bargain than one which is welded. If a screwed cassette jams, there is a reasonable chance of effecting a repair.

Typical cassette versions of well-established stereo long-play disc recordings. With improving technology, pre-recorded cassettes are exhibiting wider frequency response and lower noise level.

CRO2 TAPE: A couple of years ago, there was strong support for the idea that chromium dioxide tape would be a prerequisite for adequate hifi performance. This created uncertainty as to whether cassette decks should cater for CRO2 tape, with a switch to modify erase, bias and compensation. It also raised the question as to whether decks not so equipped would be capable only of painfully obvious "second rate" results. Since then, ferric tapes have been refined to the point where they can equal the one-time performance of CRO2 tape, without change to the recording parameters. The spectre of "second rate" performance has largely been obviated. At the same time CRO2 tape and CRO2 tape facilities have been taken up by an increased number of manufacturers. The present position is that, with a good quality deck and a good quality ferric oxide cassette, it is possible to achieve results which will satisfy the vast majority of hifi enthusiasts. On this basis, CRO2 tape and facilities can be regarded as a de luxe feature, available for the necessary extra outlay. The difference will be discernible only under optimum conditions: deck, tape, program material, and listening situation. It should be noted that special conditions are necessary only for recording on CRO2 tape. It can be played back on any deck, but whether any improvement on frequency response is noticed will depend on the playback head, amplifiers, loudspeakers, and the listener's ears.

The JVC stereo cassette deck model CD-1655U/F/S. It has "Cronios" long life heads, provision for CRO2 tape, and automatic noise suppression rather than Dolby, as such.



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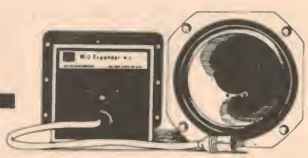

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HIFI NEWS

DOLBY SYSTEM: The situation in regard to the Dolby noise reducing system is not unlike that which applied to CRO2 tape. A couple of years ago, tape hiss was enough of a problem to convince many that Dolby compression and expansion for recording and playback was essential for hifi listening. Others disagreed and passions were heightened by the involvement of standards, compatibility, patent rights and so on. A more orderly situation has now emerged. Vastly improved tape and technology have made possible good quality recordings without the aid of Dolby compression and expansion. At the same time, the Dolby system can contribute, typically, 5dB to signal / noise ratio, which is useful to have in recordings with a wide dynamic range. The position therefore is that a deck without Dolby can produce and replay good recordings, consistent with its quality in other respects. If you can cope with the additional layout for the Dolby facility, without sacrifices in other directions, you stand to gain a significant but not sensational improvement. The other point is that the Dolby facility would be desirable if a significant number of pre-recorded cassettes are released with Dolby compensation. They play well enough on a non-Dolby deck, perhaps with a little top cut applied, but the proper dynamic compensation is obviously desirable.

ANS, Etc: One of the spin-offs from the arguments about Dolby has been a number of automatic noise suppression (ANS) circuits, which operate only on playback, leaving the recording characteristic unmodified. Proponents of such systems claim results broadly equivalent to the full Dolby treatment, emphasising that the benefits can be realised on any tape which has a poor noise characteristic. ANS or its equivalent is yet another handy feature, though it is less well known than the much-publicised Dolby system.

CRO2, DOLBY & ANS: Commercial decks variously provide one, two or all three facilities and, as extras on a basically high quality deck, they can contribute to the ultimate result. By and large they are tending to appear on the top of the line models, which is as it should be. It would be a pointless exercise — apart from being a sales gimmick — to add de-luxe extras to a deck in which the basic head, electronics and traverse systems had been skimped.

FERRITE, GLASS HEADS: Head wear has been one of the potential problems of the tape medium. While wear at the cassette speed of 1⅞ips would seemingly be less than at higher speeds, the very critical dimensions render any wear proportionately more serious. Also, a deck which may be used as a home music source, may be operated for long periods. Because of these considerations, and possibly increased wear with CRO2 tape, deck manufacturers have given a lot of attention to the development of harder head materials. There has been some problem about matching the performance of these long-life heads to the best of the conventional types but any differences now seem to be very small indeed. Long-life heads add to the cost of a deck but they would appear to be a worthwhile investment.

QUADRAPHONIC CASSETTES: This is an area which is as yet unresolved. To preserve compatibility with mono and 2-channel stereo, "discrete" quadraphonic cassettes should really have 8 separate tracks — 4 in each direction. It can be done and JVC Nivico is reportedly ready to go ahead. However, there are extreme problems with signal / noise ratio and dropouts, and there are more pessimists than optimists at present. There is no particular difficulty about producing 4-track 1-way cassettes, but lack of compatibility is the problem here. In the meantime, the most logical compromise is to produce cassettes containing matrixed quadraphonic material, the counterpart of matrixed discs. Their whole success would depend on precise alignment of the tapes and heads but manufacturers of the quality decks, at least, are claiming that their products can cope adequately with matrixed signals.

CONCLUSION: Cassettes and cassette players have emerged from the formative period and are now an established part of the hifi scene. At this stage, the medium complements rather than competes with the disc records.

Discs provide a greater range of material, with quality at least as good and at somewhat lower cost. They have the obvious advantage that one can select and play individual tracks with greater ease.

But cassettes are more versatile in that they can be used indoors, or outdoors, or in the family car. They can also be used to record material, in the manner of an ordinary open reel machine.

Manufacturers will inevitably bring out new model decks at regular intervals but the emphasis will probably be on "cosmetic" changes and revised engineering to achieve much the same end result.

In short, if you have the urge to buy a cassette player, there is no great point in delaying the decision beyond the present. The format is well established and you may as well begin to enjoy what it can offer. Tomorrow's decks will be "later models" but it will be surprising if they don't also cost more.

Company Name Change

The Chairman of Jacoby Kempthorne Pty Ltd, Mr P. H. W. Jacoby, has announced that a new company name will replace the existing one from April 1, 1974.

On that date Jacoby Kempthorne will cease to exist and Sony Kemtron Pty Ltd will be the Australian distributor for Sony audio and video equipment.

Addresses and phone numbers in all states will remain as before.

RGS/BJD TO Distribute Glenburn/McDonald Turntables

A.G.S. Electronics Ltd, one of Canada's largest audio component distributors, including Glenburn / McDonald, are now in the process of setting up Australian sales offices. A.G.S. will distribute the Glenburn / McDonald range of turntables, in conjunction with B.J.D. Electronics in Australia.

A.G.S. Electronics will control and distribute to the OEM market, while B.J.D. Electronics will distribute the hi-fi range of turntables.

Glenburn / McDonald turntables are capturing large sections of the world's market with their low-priced, high-quality line-up of models.

There is no connection between BSR / McDonald and Glenburn / McDonald, other than the name of Dr D. M. McDonald, often regarded as the dean of the record changer industry, who at one time owned BSR.

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HOW IMPORTANT IS AUDIO-COMPONENT COMPATIBILITY?

Julian Hirsch examines some of the obscure factors that affect just how well the separate units of your hi-fi system will work together . . . Part Two

Julian Hirsch, of the Hirsch-Houck Laboratory is a well known writer on hifi topics. This article is reprinted from the January 1974 issue of Stereo Review. Copyright 1973 by the Ziff-Davis Publishing Company.

Preamplifier and Accessories

Many system accessories, such as four-channel decoders, equalisers, and tape decks, are designed to be connected to an amplifier or receiver at a point in its circuit before the volume and tone controls — but after the phono-preamplifier section. At that point, the circuit can be interrupted by a switch (TAPE MONITOR) set up so that the returning signal, after going through the accessory, re-enters the preamplifier and continues on through the volume and other controls.

From the high-level (tuner, auxiliary, tape, etc.) preamplifier inputs to the tape-monitoring junction there is usually no gain and, therefore, there is normally little likelihood of overloading the accessory or tape-monitor input stage. The signal from the tape-output jack is usually under 1 volt, and all accessories can handle that level with ease. Similarly, the signal returning from the accessory is usually at about the same level, so that the preamplifier stages that follow will not be affected by the insertion of an external unit.

Perhaps the only precaution to be observed when connecting accessories is to avoid unreasonably long lengths of shielded cable. Most preamplifier tape outputs are at an impedance of 10,000 ohms or less (some are as low as 100 ohms). Even at the higher impedance typical of some low price amplifiers and receivers, up to 20 feet of shielded cable will not significantly attenuate the highest audio frequencies. The low output impedance of the top-grade preamplifiers can feed even longer cables with impunity.

It is also frequently possible to connect many accessories between the preamplifier output and the power amplifier input (this point is accessible on many integrated amplifiers, as well as all "separate" combinations) but it should be done with caution.

Some power amplifiers require as much as 2.5 volts input for full power output (even more if they have input-level controls which are not set to maximum), and many preamplifiers can deliver 5 to 10 volts before they clip the output waveform.

Most accessories will be severely overdriven if connected to a system at that signal level. Since all accessories designed for connection to the tape-monitor circuits also duplicate those connections (so as to avoid sacrificing the use of a tape recorder), there is no need to risk distortion by interposing any active devices between the preamplifier and the power amplifier.

Almost all amplifiers have high-level inputs (Aux and Tuner) that cannot be overdriven by any normal-level input signal. Even among the exceptions to this rule, we have yet to test one which cannot handle up to 3 volts input.

Preamplifier/ Power Amplifier

If your separate preamplifier and power amplifier are from the same manufacturer and are of comparable quality, there should be no problems with their electrical — or physical — compatibility. Even if they are from different manufacturers, most modern preamplifiers and power amplifiers will work well together.

One possible problem source is the low input impedance of solid-state power amplifiers as compared to the 250,000-ohm or higher impedance of vacuum-tube amplifiers. But as long as the load (the power-amplifier input impedance) is at least ten times the source impedance (the preamplifier output impedance), you can expect to obtain satisfactory performance.

Today's solid-state power amplifiers rarely have an input impedance higher than 100,000 ohms, and on some high-power amplifiers it is as low as 10,000 ohms. A preamp that can't drive such an impedance may not be able to deliver its rated output to such an amplifier without distortion or attenuation of the lowest audio frequencies.

When a power amplifier has an unusually low input impedance, the output response of a conventional solid-state preamp may be affected in the lowest audible range, if only by a couple of decibels. Although this loss is usually audibly insignificant, it has probably been responsible for some of the differences claimed to have been heard between competitive power amplifiers whose frequency response actually extended well below (and above) the audible range. The real difference, of course, was in the input impedance of the two amplifiers rather than in their frequency response or other more esoteric characteristics that for some reason were not susceptible to measurement.

Response loss can be a more serious problem when driving a solid-state power amplifier from a tube-type preamplifier. The loss of bass from such a pairing can be

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THORENS — Swiss transcription turntables. The electronic TD-125 Mk II is the unit selected by many of the world's reviewers and electronic buffs. Demand for the less expensive TD-160 still exceeds supply in both European and overseas markets. Both models available with and without bases, arms, etc.

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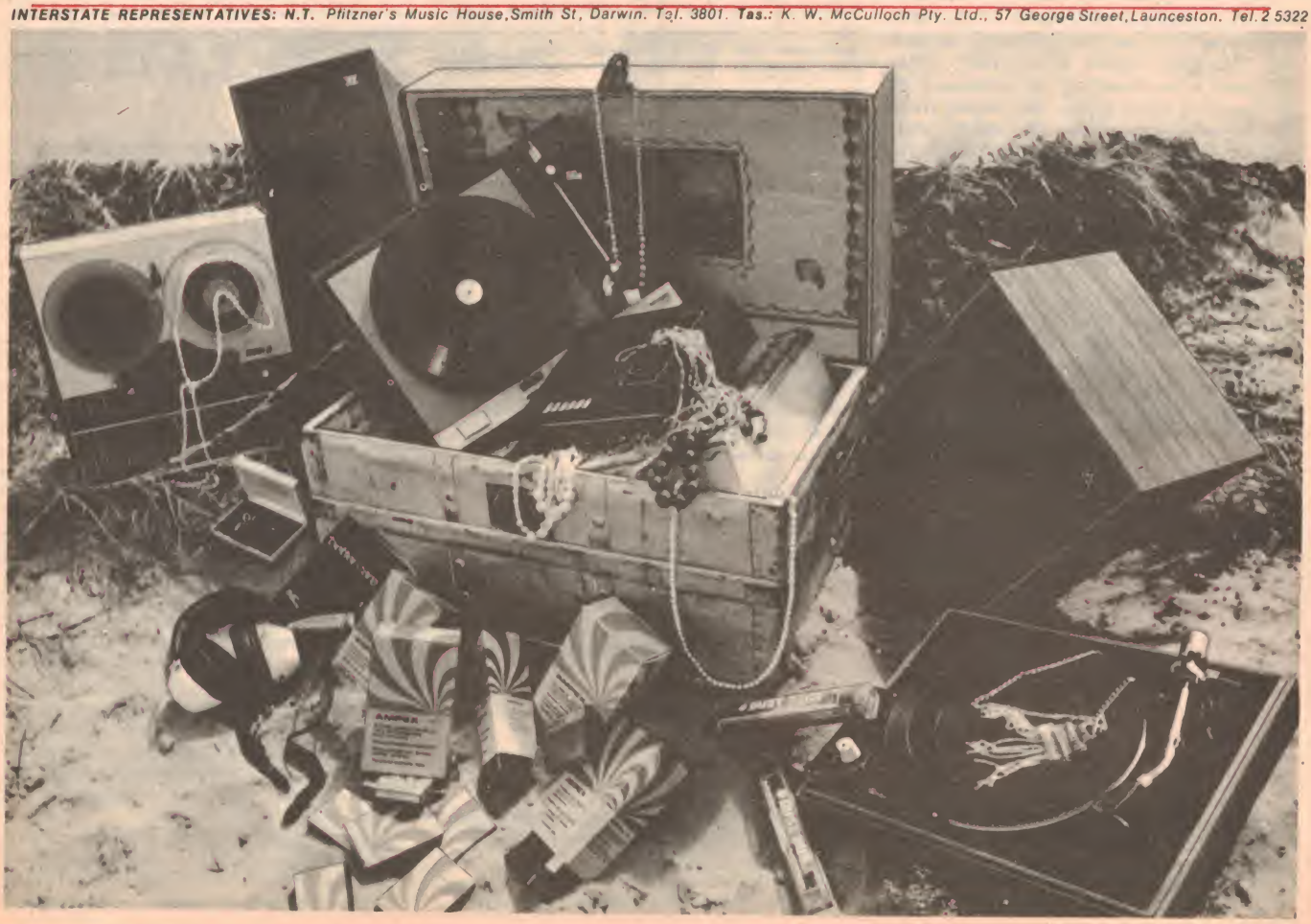

COMPATIBILITY

severe. Possible cures, in order of their desirability, are:

1. change to a solid-state preamplifier,
2. use a power amplifier with a higher input impedance,
3. increase the size of the preamplifier's output capacitors (this is rarely practical).

A further possible source of incompatibility is the transient output surge of a tube preamplifier during warm-up. Tube-type power amplifiers, which had about the same "warm-up" time as the preamplifiers, did not allow this surge to reach the speakers, and its presence was usually unsuspected by the user.

Most solid-state power amplifiers are fully "on" within a second or two after power is applied, and they can be driven to saturation by the preamplifier surge. Particularly when the speaker outputs are direct-coupled, as many are today, a huge signal may be applied to the speakers. At the very least, the result is an unpleasant thump; if the amplifier is of the "super-power" variety, the risk of damaging the speaker is high.

The problem can be avoided by turning the preamplifier on before the power amplifier. The convenience of running the power amplifier from one of the preamp's switched AC outlets must then, of course, be sacrificed.

Some amplifiers have automatic protective circuits which will shut them down during the surge; on others, the speaker fuses may blow out. Either result is obviously undesirable. A few amplifiers have turn-on time delays designed to eliminate a similar effect (though of much lesser degree) from the associated solid-state preamplifier. The delay is rarely more than a few seconds, and may therefore offer no protection against the starting surge of a vacuum-tube preamp.

We strongly recommend that vacuum-tube preamplifiers, no matter how highly regarded, never be used with solid-state power amplifiers, unless they are specifically designed for solid-state compatibility. A good solid-state preamp is probably cheaper than either a new power amplifier or a pair of speakers, and it offers many other advantages in flexibility and improved performance over the best vacuum-tube preamps.

Those who hear "better sound" from tube preamps and who wish therefore to mate them with high-power transistor power amplifiers should know the risks they run — and perhaps they should investigate the possibility that the "poorer" sound they hear from solid-state preamps may result from one of the kinds of incompatibility noted above.

And finally, I see no reason why a solid-state preamplifier could not be used with a tube power amplifier.

Tape recorder/ Tape

There are normally no interface problems between the tape deck and the amplifier. All recorders return a playback signal at approximately the same level as the recorded program (or can be adjusted to do so), and have input-gain controls with sufficient range to accommodate any input signal from an amplifier's tape outputs (which can vary from less than 100mV to more than 1 volt).

The only possible trouble would occur when taping with an old recorder (say, more than six years old) and/or an FM tuner of similar or earlier vintage. Some early stereo tuners had considerable 19-kHz and 38-kHz content in their audio outputs (from the stereo FM pilot tone), which in certain tape decks could "beat" (combine and form a new frequency) with the bias oscillator in the recorder to produce "birdies" or whistles on the tape. This is unlikely to occur when either or both components are of recent manufacture, since filtering circuits are incorporated in almost all current designs.

More significant in respect to compatibility is the relationship between the tape used and the recorder. Each tape-oxide formulation (the mixture of microscopic magnetic particles that coats the plastic tape-base material) requires a particular combination of recording-bias level, signal level, and equalisation if it is to deliver its optimum performance. These parameters are adjusted by the tape recorder manufacturer, either for a specific tape or for a general class of tape (usually identified as "standard," "high output," etc). Frequently, the recorder manufacturer does not name specific brands and types of tape, leaving the user to guess or determine by experiment which tape his machine has been "set up" for.

In the case of open-reel recorders, these adjustments are relatively noncritical, at least for the purposes of most home recordists. The most obvious difference in sound between a "standard" tape and one of the premium types is the slightly better high-frequency response of the latter, but in the audible frequency range these differences are slight (except possibly when operating at the lowerst tape speeds). Still, it is advisable, in the absence of specific recommendations by the recorder manufacturer, to try several types of tape and standardise on the one that seems less sensitive to overload distortion and provides the smoothest and most extended frequency response.

Avoid "bargain" or unbranded tapes, which can be rejects of a regular tape brand with, in addition to uncertain magnetic properties, surface imperfections or loose coatings that might clog the recorder's heads or internal mechanisms.

Cassette tapes have the same general compatibility requirements, but with some very important differences. Unlike the case with open-reel machines, bias and equalisation in a cassette recorder must be critically matched to the tape used; even a slight misadjustment can drastically affect the high-frequency response as well as the distortion and signal-to-noise ratio. This adjustment is almost never accessible to the user, and few cassette-recorder manufacturers identify suitable tapes by brand name.

If the instruction manual for your cassette machine does recommend specific tape brands, use them (or others of comparable performance). Otherwise, we would suggest trying several kinds of tape and judging for yourself which are most suitable. While two makes of high-performance tape may sound very much alike (and would be equally suitable for your needs), the duller high frequency response and irregular output level of some of the cheaper brands will be immediately audible.

Tone Controls/ Speaker Character

All amplifiers have bass and treble tone controls, and most will do an acceptable job of altering overall tonal balance to suit individual taste or the acoustical characteristics of the listening room. However, few are of any value for equalising loudspeaker response. Several speaker manufacturers have designed equalisers for their speaker systems, and these generally boost the lows and highs of the loudspeaker. The response curves of these equalisers, though they differ from each other, have one thing in common: they cannot be approximated by the usual tone controls on any standard amplifier.

Typical loudspeaker-system frequency-response deficiences include:

1. Gradual roll-off of high-frequency output, usually beginning at some point between 8,000 and 12,000Hz.
2. Smooth, but fairly rapid, loss of response below some bass frequency, usually between 40 and 100Hz.
3. A broad hump or dip (or several) in the response curve, occurring at any frequency in the audible range.
4. Relatively narrow-band peaks or dips, perhaps less than one-third of an octave in width, usually in the mid-range between 400 and 2,000Hz.

Each of these frequency aberrations imparts its own coloration to the sound, and its reduction or eliminatinn can make a significant improvement in listening quality. Sometimes the resulting improvement is rather subtle (especially in the deep bass), but when it can be achieved, it is audibly worthwhile.

There are some amplifier tone controls which can provide useful equalisation at the lowest and highest frequencies (cases 1 and 2 above). This requires that their "turn-over" frequencies (the point at which the control starts to be effective) be located near the ends of the musical spectrum (200Hz or below, 8,000Hz and above), rather than the usual 600 to 800Hz and 1,000 to 2,000Hz points. This capability is found in a few top-price amplifiers.

A more effective arrangement can adjust for speaker problems 1, 2, and 3. This is the "graphic equaliser," which has five or more controls providing boost or cut at

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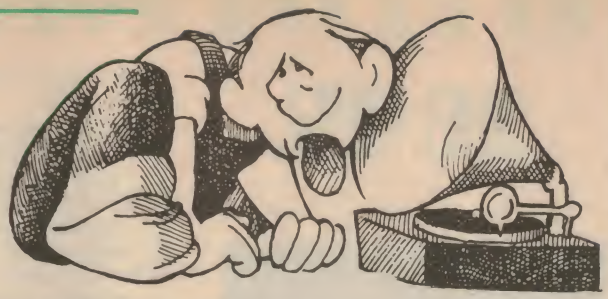
COMPATIBILITY
Continued



specific frequencies. Graphic equalisers are incorporated in some amplifiers and receivers and are also available from several manufacturers as add-on accessories. The narrow-band response irregularities are beyond the corrective capabilities of any practicable home equaliser, however — except, in some cases the very expensive one-third-octove variety. If your speakers have narrow-band problems, and if they bother you, the only solution is to change speakers.

Amplifier Power/Speaker Rating

Few aspects of audio-system planning cause as much confusion as the selection of speakers and amplifiers whose power ratings are compatible with each other as well as with the listening requirements of the purchaser. None of this has anything to do directly with how the speakers sound, of course.

First of all, there are no hard-and-fast rules in the matching of speaker and amplifier. There are as many solutions as there are installations, for no two are alike. Luckily, even rather large "errors" need not be disastrous to the speakers or to your listening sensibilities.

There are actually several distinct questions to be answered:

1. How much sound-pressure level (SPL) is needed at the listener's ear to provide the desired sensation of loudness realism with the preferred program material?
2. Can a given speaker (which presumably meets other standards of sound quality) produce that level in the listening room without excessive distortion — or damage to the speaker?
3. Can the amplifier supply enough electrical power to generate the desired acoustic level for a given set of speakers?
4. At the amplifier's maximum power (if this exceeds the requirement of item 3), is there a risk of damaging the speaker?

Unfortunately, the data published by most speaker manufacturers will not provide direct answers to most of these questions. This is not the manufacturer's fault, for there are simply too many factors involved, all of them beyond his knowledge or control.

For example, the sound-pressure level in a given room, for any selected speaker and electrical drive power, depends on the room acoustics, which are determined by room dimensions, shape, and furnishings, by speaker placement and listening location, and many other factors.

From time, to time, guidelines have been published to assist the buyer in choosing an amplifier-power rating, but these are so broad and general as to be virtually useless.

One's personal listening habits may well be more important than all the above-mentioned factors. Between a background-music level and realistic reproduction of, say, rock music, there can be a volume range of more than 30dB, which translates to an amplifier power ratio of 1,000! Quite possibly, the question of whether the amplifier used should be rated at 1 watt or 1,000 watts is more meaningful than whether it should be 40 watts or 60 watts.

Many speaker manufacturers publish a maximum and minimum "power rating" for their products. The minimum recommended amplifier power rating (in continuous watts per channel) means that the manufacturer believes that an amplifier with at least that much power can drive his speaker to comfortable levels in a "typical" listening room. The maximum power rating of a speaker would seem to be unambiguous, but it is rarely stated whether it is based on escessive distortion or on actual damage to the speaker.

Take a typical case: a small bookshelf speaker might carry a minimum rating of 10 watts, and a maximum rating of 50 watts. One could infer from this that practically any contemporary receiver or amplifier would be satisfactory for use with this speaker, and this is probably true. However, considering the substantial investment represented by a good stereo receiver, we would suggest choosing near the upper end of the power range if at all possible. This leaves the path clear to upgrading the system with another set of speakers — possibly less efficient — without making the receiver obsolete.

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COMPATIBILITY

Continued

For reasons of economics, aesthetics, or even sheer ignorance, an attempt is sometimes made to fill a large, well-furnished room with a pair of inexpensive little speakers driven by a low-power amplifier. Then, when a more powerful amplifier is brought in to provide adequate listening levels for the room, distorted sound and (quite possibly) damaged speakers are the almost certain result.

Does this mean that small speakers cannot be used in large rooms? Not necessarily. If in doubt, let price be your (rough) guide: a pair of good $250 speakers may be only slightly (if at all) larger than a pair of good $100 speakers, but they will almost certainly be able to deliver a higher volume of undistorted sound. In addition to this, a compact speaker with extended bass response will be less efficient than either a large system with the same response or a system of similar size with restricted low-frequency performance. Lower efficiency means more electrical power required for a given SPL, which explains why the better acoustic-suspension systems often require 50 watts or more amplifier power.

Because the speaker ultimately determines the total sound of the system, its performance should be the primary deciding factor. Once the speaker has been selected, it is easy to choose an amplifier with enough power. And there is no reason why an amplifier whose maximum power rating exceeds that of the speaker cannot be used. The availability of very high amplifier power when it is required can greatly enhance realistic reproduction of music, even at rather modest average levels. However, when the available amplifier power exceeds the speaker rating, the speaker must be protected by a fuse — or other device — from accidental overloads.

A number of speaker systems have built-in protective fuses which will open the circuit before damage occurs. However, most tweeters will be burned out if fed continuous high-frequency signals even at at a power level below the system's overall power rating. This is true even though they can handle the high-frequency energy in music at the full power level.

If your speaker does not have fuses, they can be added externally. But don't choose your fuse rating on the basis of a simple Ohm's Law calculation. A 50-watt, 8 ohm speaker supposedly requires 2.5 amperes at full power, and one might be tempted to use a 2-ampere fuse and feel it is protected. Actually, this is only a "half-safe" condition, since the speaker impedance probably varies widely with frequency and some of the drivers might require a lower-amperage fuse for adequate protection. Some speaker manufacturers specify very fast-acting fuses, while others prefer the slow-blow type. Contact the speaker manufacturer for his specific recommendation.

Amplifier Damping/ Loudspeakers

The damping factor (DF) of an amplifier is the ratio of the rated load impedance (usually 8 ohms) to its internal impedance. It is a measure of the "regulation" of the amplifier — that is, how much the amplifier's output-signal voltage (all other factors being held constant) will vary with changes in the impedance of the load (speaker). Since the amplifier output impedance exerts some measure of control over the speaker's voice-coil movement (especially in the vicinity of the woofer bass resonance), it has been considered by many to be an important factor in providing a "tight" bass response, without excessive hangover or other undesirable transient effects.

Up to a point, this is true. A measurable (and audible) difference in the low-frequency response of many speakers can be observed when one increses the DF from 1 to perhaps 10. On the theory that, if a little is good, a lot must be better, some people have become convinced that a very high DF (it is often over 100, and sometimes as high as 1,000 on modern amplifiers) offers real advantages in listening quality.

To see why this cannot be true, one has only to look at the equivalent electrical circuit of the amplifier output and speaker. To start with, we have the woofer voice coil's DC resistance (usually 25 to 50 per cent of the rated voice-coil impedance). Then there are other resistances, including those of the crossover network and the connecting wires to the amplifier. At the amplifier itself we have a "source" impedance which relates to the damping factor. If the amplifier's DF is 1, then, with an 8 ohm speaker, the source impedance is 8 ohms. (With a DF of 10, the source impedance is 0.8 ohm, and with a DF of 1,000 source impedance is 0.008 ohm.)

The speaker voice-coil "sees" and is damped by the sum of all the resistances in this circuit. For a typical 8 ohm speaker connected to a typical low-price amplifier with a DF of 10, the total resistance (source impedance plus voice-coil, crossover, and connecting-wire resistances) works out to 2.9 ohms. If we switch to an amplifier with a DF of 1,000, the load seen by the speaker is "improved" from 2.9 ohms to 2.108 ohms — hardly a substantial gain.

The conclusion is inescapable: damping factor per se is of almost no importance as long as it is more than about 10. Amplifiers with much higher DF values may sound better, but only because they generally have much higher power and large amounts of negative feedback (which only incidentally results in a very high damping factor).

Conclusion

Although a book might very easily be written on the subject, we have touched in these pages on enough of the key points of system planning and compatibility for one central fact to emerge: common sense is still the most important and useful aid when it comes to matching audio components successfully.

A $1,000 tuner is wasted on a $100 amplifier or on a pair of $50 speakers. A fine $400 amplifier can only bring out the worst in a pair of low-cost "Brand X" speakers or a $100 AM / FM stereo tuner. A $200 receiver might sound acceptable enough with those same $50 speakers, but it could be quite disappointing with a pair of fine $500 speaker systems. And to use a $100 phono cartridge in a $50 record player is equivalent to installing a $200 set of radial tyres on a 10-year-old heap!

Thus, aside from the more arcane matters discussed above — and they do have their effects — there is really no great difficulty about matching your audio components to each other for best performance — provided there is all round common sense. The manufacturing companies are interested in having their products work properly not only with other units of their manufacture, but with those — as many as possible — made by others as well. Further, standardisation within the audio industry, though not total, is quite impressive, given the large number of companies involved. Thus, common sense, reasonable caution, and a few simple showroom tests are all that is required to assure compatibility, to enable you to realise in your home the fidelity potential inherent in today's component stereo (and quadraphonic) equipment.

News Highlights

Revolutionary new IC for signal processing

A new semiconductor device for analogue signal processing, with more than 100 times the computational power and speed of conventional components, has been developed by scientists at the General Electric Research and Development Centre, Schenectady, NY.

Called a surface charge correlator, the new integrated circuit is expected to make dramatic reductions in the cost and complexity of detecting signals buried in noise and other interference in radar and sonar systems. The new device will also result in substantial reductions in the amount of computer power now required in radar and sonar systems.

The tiny GE circuit chip (0.115 x 0.066 inch) can perform 32 multiplications and additions in less than a millionth of a second. By contrast, today's computers typically require several millionths of a second to make either a single addition or multiplication.

"Potential applications for the new surface charge correlator cut across the entire spectrum of radar, signal detection, and communications technology, including television sets and mobile radio," Dr Arthur M. Bueche, GE Vice-President for Research and Development, said recently.

Key to the speed and computational power of the GE surface charge correlator is a new "charge-sloshing" structure that elinates a major problem of most charge-coupled devices (CCDs) — the loss of some of the charge that represents the signals. This "charge transfer loss" has limited the performance of CCDs up to now.

According to the GE scientists, presently available charge transfer devices contain many storage capacitors for controlling and moving charge packets across a silicon chip. As current flows from one capacitor to another, however, a tiny fraction of the signal charge is left behind. After several thousand transfers, the GE scientists say, "the misplaced charges build up to an appreciable fraction of the original charge, causing degradation of the output signal."

Not so with the "charge-sloshing" method built into GE's new surface charge correlator. In tests at the GE Research and Development Centre involving some two million transfer operations, charge sloshing prevented any cumulative signal loss whatsoever.

Briefly, the new GE technique causes the charge in the chip to slosh back and forth between portions of a single charge storage region. If any charge is left behind on one transfer, it is picked up on the next transfer. According to the GE scientists, charge sloshing "makes it possible to build signal processing devices that cannot now be built with conventional serial charge transfer devices,"

The new GE circuit fits into a standard 16-pin integrated circuit package, and performs correlations of 32 binary weights against 32 continuously variable analogue samples. Greater accuracy can be achieved by combining the modules in parallel, while correlations over a greater number of points can be achieved by combining them in series. The integrated circuits are fabricated by the standard process now used to produce large scale integration (LSI) metal oxide semiconductor (MOS) chips, and are expected to cost about the same.

US offers solar technology exchange

US scientists, speaking at the opening of the Solar Energy Workshop at Sydney University recently, have proposed an agreement with Australia to exchange scientific knowledge and technology in the rapidly growing field of solar energy. The offer came from Dr Frederick B. Morse (University of Maryland) who is co-ordinator of solar energy research for the US National Science Foundation.

During his opening speech, the Minister for Science, Mr W. L. Morrison, said that the Australian Government would back solar energy to the best of its ability. The Minister also said that the Australian Research Grants Committee would allow scientists from the universities to put forward proposals for research in the field. "Should meritorious projects concerned with solar energy exceed available funds, we will respond favourably," he added Eight American scientists and engineers attended the workshop opening, together with Australians from government agencies, state power authorities, the universities and the CSIRO.

NS calculator now only $27.75

National Semiconductor has reduced the price of its NS Electronics Model 600 6-digit pocket calculator (featured in the December 1973 issue of "Electronics Australia") from $29.95 to $27.75. At the same time, the company has introduced a 9-digit calculator, the NS Model 900, which will retail for just $32.50.

The NS900 is the second in a family of consumer electronic products that will be manufactured and sold by NS Electronics. Both the NS600 and the NS900 add, subtract, multiply and divide, and can do automatic addition, subtraction and squaring. Both machines also have a fixed two-place decimal. An optional AC adapter to suit both models will be available in the near future.

Military satellite

Britain's Skynet II, the first operational communications satellite designed and built outside the USA or Russia, was recently launched from Cape Kennedy by a Thor-Delta rocket. The 960lb satellite was designed and built for the Ministry of Defence by Marconi Space and Defence Systems Limited, a GEC-Marconi Electronics company, under a contract placed by the MOD Procurement Executive.

Together with its sister spacecraft, which is to be launched later this year, it will form the space segment of the most comprehensive military satellite communications system in the world, carrying British defence communications over an area from the UK to the Far East. These spacecraft will replace the smaller, US designed and built, Skynet I satellites now in orbit.

The prime contractor, Marconi Space and Defence Systems Ltd, has built equipment for every British satellite and is now the first UK electronics company to take the prime responsibility. The Philco-Ford Corporation, a subsidiary of the Ford Motor Company of America, is Marconi's major sub-contractor on the Skynet II project, providing important sub-systems and components.

Death of Sir Lionel Hooke

Sir Lionel Hooke, Chairman of Amalgamated Wireless (Australasia) Ltd, died on the 17th February after a short illness. Sir Lionel, who was knighted in 1957. had been AWA's Chairman since 1962.

Born at Brighton.(Victoria) on December 31, 1895, and educated at Brighton Grammar School, Sir Lionel was the pioneer of the Australian electronics industry.

During Sir Lionel's term as Chairman, AWA designed and produced the first integrated circuits made in Australia, won contracts to maintain and operate space tracking stations, designed Australia's first colour television transmitter and developed and manufactured a wide range of complex electronic equipment for the Defence Services and Government and commercial users, both here and overseas.

The late Sir Lionel Hooke was also Chairman of Amalgamated Wireless Valve Co. Pty Ltd, a Director of the Australian Gas Light Company, Email Limited, and United Telecasters Sydney Limited. He was Chairman of the Electronics and

Telecommunications Industry Advisory Committee and had been a member of the Senate of the University of Sydney for ten years.

Free valve testing service

The first Mercury valve tester to be imported here from the USA has recently been installed at the Dick Smith Electronics Centre, Gore Hill. Customers may use the tester completely free of charge.

The tester can be used to check over 1,700 tube types (including Nuvistors, 10 pin types, and even car radio vibrators) for emission, shorts and gas. Easy to follow flip charts give the settings for the two controls needed to check any valve. A large panel meter gives an indication of the state of the valve on a pass / fail rating.

The free valve testing service should prove particularly valuable to purchasers of the Telefix calculator. The Telefix, priced at two dollars, enables TV owners to trace a large number of faults to a particular valve. The owner then simply has to check the valve on the Mercury tester to confirm his diagnosis.

Pocket programmable calculator

The first pocket-sized calculator to give users full programming capability has been placed on the market by Hewlett-Packard.

Designated the HP-65, the new pocket calculator enables users to write and edit their own programs, to use pre-recorded programs (devloped by Hewlett-Packard) which solve many frequently encountered problems in a variety of disciplines, and to operate the 51 keyboard functions pre-programmed into the machine.

No previous programming experience is required to operate the HP-65. The calculator has five master keys (A-E) for storing and recalling programs written by the user. Editing is done with a few simple keystrokes. When a recorded program is no longer needed, the magnetic card can be erased and re-used to record another program.

The HP-65's keyboard has 51 calculating functions and data manipulation operations. Many of the keys can perform four functions. Included among the pre-programmed functions are the standard arithmetic operations, logarithms — both natural and common — square and square root, exponential, factorial, reciprocal and trigonometric functions. When used in a program, each of these built-in functions occupies only two program steps. One program containing up to 100 steps, or many programs totalling 100 steps, can be recorded on a single card.

The HP-65 can add and subtract in degrees, minutes and seconds format, allowing it to also perform calculations involving hours, minutes and seconds. It also will operate in any of three trigonometric modes — degrees, grads and radians — and will convert octal-based integer numbers to decimal-based integer numbers and back.

The unit has nine addressable memory registers, resulting in far greater memory capacity than in any other pocket-sized calculator except the HP-45. This extended memory, plus the calculator's ability to perform 51 built-in functions, enables the user to solve complex, multi-step problems

with greater ease and in less time than possible with comparable desk-top machines.

For further information contact Hewlett-Packard Australia Pty Ltd, 31-51 Joseph St, Blackburn. Victoria 3130. Telephone 89-6351.

NEWS HIGHLIGHTS

Prime Minister opens OTC building

Above, a technical officer interrogates the processor of the computer-controlled international telephone exchange at the new OTC International Telecommunications Terminal, Broadway, Sydney. The new terminal was officially opened on February 21 by the Prime Minister, Mr Whitlam. A highlight of the opening was a televised satellite meeting between the Prime Minister and the West German Chancellor, Mr Willi Brandt.

Computerised directory assistance

A new computer-controlled visual display system, capable of substantially reducing the time it takes directory assistance operators to find customers' telephone numbers, will be installed in the suburban Los Angeles area during the next two years by the General Telephone Company of California.

The electronic "rapid retrieval" systems are the first to be installed on a permanent basis in directory assistance offices in the US. They are among several types of automatic number-finding systems developed by General Telephone of California, a subsidiary of General Telephone & Electronics Corporation, and other telephone companies in recent years.

The new system employs computer-controlled viewing devices that display filmed listings of the telephone numbers. The microfilm is stored in the viewer in six inch strips, each strip containing several thousand listings. Up to 15 million listings can be stored in the one viewer.

To find a customer's listing, the operator simply presses keys, on the viewing machine console, representing the first four letters in the last name of the person whose number is being sought. She also presses keys representing geographical areas covered by specific printed directories and, if necessary, a key for the "daily addendum" of new and changed listings. A new addendum is added to the machine's "bank" of microfilm each day to keep the listings up to date.

A small computer in the office processes the information provided by the operator, and instructs her viewing terminal to project, on its screen, the section of microfilm containing the desired listing.

The company decided to install the new system in its suburban Los Angeles operating area following a successful test of the equipment at the Santa Monica Directory Assistance office from August 1971 to September 1972. Initially, the viewing machines were installed at 10 operators' desks for handling regular calls from the public. Seven months later the remaining 38 operators' positions in the office also received the viewers.

An additional 444 viewing terminals will be installed at the company's nine other suburban Los Angeles directory assistance offices this year and next at an estimated cost of $US2.5 million. — George E. Toles.

Plessey develops high flux solar cell

At present the high cost of photovoltaic solar cells prohibits their use in the large scale generation of electricity from sunlight. However, the Plessey Company's Allen Clark Research Centre, Northhamptonshire, UK, has recently demonstrated that suitably designed gallium arsenide / gallium aluminium arsenide heterostructure junction semiconductor solar cells can be operated at light intensities of up to 2,000 times full sunlight concentration to produce specific power outputs of between 20 and 40W per square centimetre. These figures compare more than favourably with silicon cells where the maximum usable sunlight concentration is about 10 times.

This high concentration is possible because the (Ga,Al) As material is relatively transparent to sunlight so that the surface layer over the junction can be much thicker than is the case with silicon, giving a lower electrical resistance and allowing much high power to be generated. Cheap concentrators, such as curved mirrors or Fresnel lenses can thus be used to focus the sun's rays onto small area solar cells, thereby greatly reducing the unit cost of the electricity produced.

The optimum working voltage and efficiency of gallium arsenide solar cells increases with light intensity, and at 2,000 times full sunlight concentration an efficiency of 24 per cent is forecast. Efficiencies approaching this value have already been achieved with non-bloomed and non-optimised cells of this type.

New spotlight spinoff from NASA technology

A new, portable, battery-powered spotlight, the brightest hand-held light every produced for its type, has been developed as a result of arc light research conducted by NASA more than five years ago.

The intense, true colour light beam of the new spotlight has a peak capability of one million candlepower, roughly 50 times brighter than the high-beam headlights of an automobile. The unit should be particularly useful to police and fire departments and to the general public in emergency situations.

Called the Stream Lite-1Million, the three kilogram (seven pound) light uses a unique xenon lamp with an operating lifetime of at least 200 hours at maximum intensity. Xenon is a heavy, colourless, inert gaseous element. The basic technology for the spotlight stems from NASA progrms for the design of engineering models of a concentric electrode arc needed in spacecraft environmental test chambers.

The Stream Lite-1Million can operate in a steady or pulsed light mode. Its intense beam is especially useful for penetrating fog and smoke since the beam suffers less return light "back scatter" than conventional light sources. It operates on a standard 12-volt direct current, rechargeable, portable battery pack or from the cigarette lighter receptacle of an automobile.

The new light is being produced by Streamlight, Inc, 123-A Clinton Rd, Fairfield, NJ 07006. It retails for about US$400.

Dick Smith Electronics Centre

STUPENDOUS IC BREAKTHROUGH

The fascinating Printegrated Circuit Story

Most people are familiar with the normal planar approach to IC manufacture. Components are formed from what are basically arrays of transistors. Resistors are transistor bases without emitter diffusion and elongated. Capacitors are enlarged base-emitter junctions while diodes are transistors with base and collector shorted. Thus by simple geometry in a single plane all circuit functions can be produced from transistors.

Dr Hiroshi Owarta, President of the Owarta Gas Diffusion Corporation, has spent five years investigating the possibility of simplifying the manufacture of ICs. His firm specialises in the production of dopants for conventional IC manufacturers.

Owarta's research started from the basic injection transistor. The famous patent of Liwinkl and Kleeb at Bell Labs (see Bell Lab Records 47,1968 p269-273) indicated the possibility of an IG FET consisting of N^- or P^- semiconductor with diffused regions of $P+$ or $N+$ Fig 1 compares a conventional FET with the Owarta device.

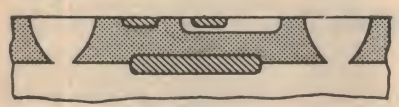
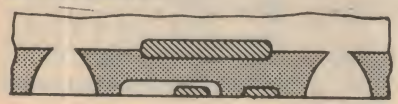


Fig 1 The similarity between the conventional IG FET and its Owarta counterpart is evident in these diagrams showing (above) the IG FET and (below) the Owarta device.



Dopants used in the Owarta IG FET are in the form of microscopic gas molecules suspended in suitable carrier domains and deposited by a technique similar to thick film deposition. Under the influence of strong electric fields the dopants concentrate to form layers similar to conventional epitaxial layer growth.

The advantage of the Owarta process is that circuits can literally be printed by incorporating the $P+$ layers and N^- dopants in suitable binders — inks of carefully controlled viscosity. After each layer is printed an electric field of approx 200kV per cm is applied to the paper causing the orientation required (see Fig. 2).

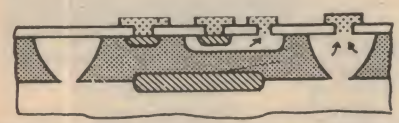


Fig 2 The device shown in fig 1 has now been subjected to the electrostatic field and new layers formed by migrational orientation of the carrier domains.

The action of migration is described by Drs Munchwitzen and Kolmacher who carried out the research for Owarta in an article published last December in Elektronische Festkorperbauchemente Part IV Nachrichtentecknik 15. The diffusion takes place in P+Lithium Siliconexaphalosulphinechloride.

Fig 3 The apparatus specially used in this experimental run to provide the 20kV / cm field. The high voltage cable can be seen top centre above the roller over which the paper passes (ink side downwards). The coil on the left is used for control purposes. The press was run at a quarter its normal speed of 6000J / w.

One of the problems with the process at present is the speed at which circuits can be printed. For this reason the circuit given here is larger than normal so that components could be formed from a number of parallel connections where deposition was critical. We are grateful for the co-operation given by Sungravure in the modifications carried out to their presses for this experimental run.

Dick Smith is proud to announce that he has obtained the first licence in Australia for the production of integrated circuits by the revolutionary Owarta Gas Diffusion Process (world patents pending).

Here for the first time ever in a magazine is an actual amplifier for the home constructor. Follow the instructions carefully and build it as your next project!!!

Your Printegrated Circuit (P.R.I.C.)

This IC contains 35 semiconductor components which together form an amplifier. The first 3 transistors are a conventional pre-amp which is followed by a 10 transistor power amp. Class AB is used with generous feedback to eliminate cross-over distortion. Direct coupling ensures a wide frequency response.

Output: 500MW peak.
Frequency response: 5Hz to 500kHz ± 3db.
Total Harmonic distortion: less than 0.5% at 100W.
Load: 15 ohm.
Power Gain: 110db.
Input: 1mV into 1 Megohm.
Power supply: 3 to 6V (MAX).

This is an actual working IC amp!

How to Use Your Printegrated Circuit

As you can see from the brief description, the electrostatic diffusion process is very critical. FOLLOW THESE INSTRUCTIONS VERY CAREFULLY.

1. Cut round the edge of the P.R.I.C. very carefully.

2. We suggest that you hold the P.R.I.C. up to the light. You will then be able to see how complex the layers are in it.

3. Prepare a saturated solution of common salt and soak the P.R.I.C. in it for 30 mins. The salt solution neutralises any electrostatic charges built up by friction between the pages and ensures good heat sinking action.

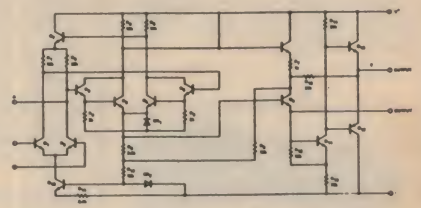
4. Dry the P.R.I.C. on a flat surface then stick it to a piece of aluminium or brass.

5. Connections would normally be soldered joint to metal pads, but this was not possible on the printing plant used. Use sticky tape to hold the wires in position. DO NOT DISTURB TAPE AFTER MAKING CONNECTION.

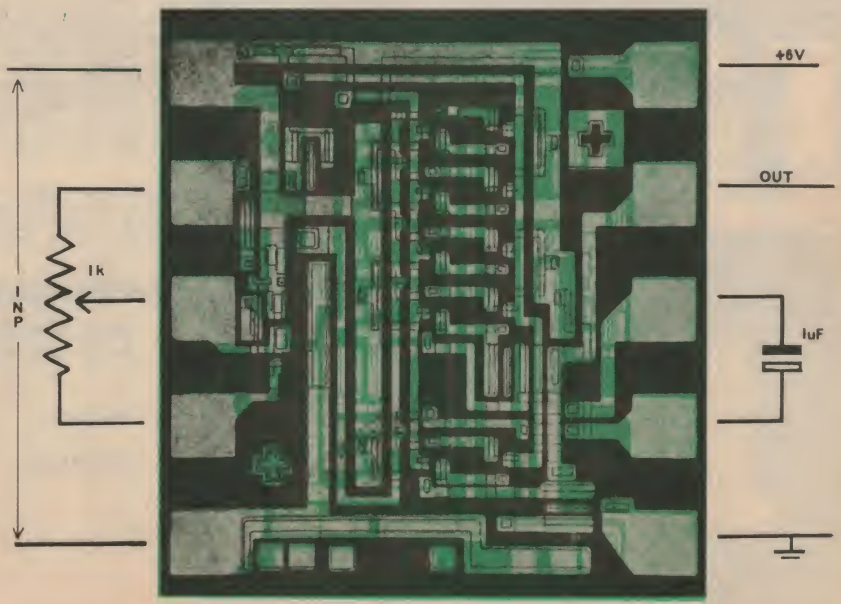
6. Connect input and load and apply power. DO NOT EXCEED 6V OR CIRCUIT WILL BE DAMAGED.

7. You can check operation by CAREFULLY applying your test prods (2Mohm meter) to the various areas on the P.R.I.C.

Watch our ads for further P.R.I.C.'s — 2048 ROM for only $3.50 10 transistor radio kit less speaker, ferrite bar and tuner $1.75. Both these and many more coming shortly!



Above is the schematic of this, the first ever, integrated circuit actually printed in a magazine. All the circuit elements (apart from a feedback capacitor) are printed here in the Owarta P.R.I.C. below. Hold up to light to see intricate pattern of components.



Dick Smith Electronics Centre

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Both these Sinclair offers are covered by usual guarantees etc. Beautifully finished and presented with comprehensive manuals. Why build when you can get ready built and tested so cheaply?

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Just In

JUST IN Solid State Car Radios. You know how hard it is to get a car radio at present? Well we've got hold of a great package deal. The SS9 (Nine semiconductors) radio complete with Lockdown aerial and speaker for just $42.95. SS12 (12 semiconductors) $49.95.

Handy Mains/Battery Socket

Building equipment to run off mains and battery? Then you'll need our handy AS021 AP021 plug and socket combination. The socket has a built-in microswitch operated by the plug, so you get automatic change-over from battery to mains when plug is inserted. As used by professional equipment manufacturers. Saves flat batteries and is as cheap as conventional power connections. Socket AS021 50c Plug AP021 25c (Both P&P 30c).

Mystified by the panel below? Then turn back a page. We thought we'd celebrate the fact that E.A. is always published on the first Monday of the month. So have a good laugh!!!

Kits

Ultrasonic Experiments (E.A. Feb 74) uses the 105 transducers we are importing. Range to 80 feet. Transmitter kit $9.75. Receiver kit $19.75 or get the complete kit for $29.50.
Digital Voltmeter (E.A. Oct 73) uses the fantastic Analogue Devices Panelmeter. 3½ digit display. Max error ±0.05% +1 digit .200mV to 2kV and 200ohm to 200k. Complete kit $145 Panelmeter alone $102.
VHF Amp (E.A. Jan 74) only from us gives 30W out from 300mV at 144MHz from 12.6V 7W stage complete $11.50, 15W $13.50, 30W $17.50. Individual boards (specify $1.50 each. Or COMPLETE kit (saves $5) for $37.50.
Power controllers. The Popular DSE Superkits for motor control etc up to 750 Watts. DSE11 kit has 10A SCR all parts and circuit for only $5.75. DSE12 kit includes all the necessary hardware, case etc for $9.25.
VHF converter (E.A. Aug 73) wind your own coils for bands between 50 and 150MHz $21.50 ex metalwork.

Transistor Radio Bargain

Look at the picture. It's a handsome little job isn't it? 6 transistors, yes a proper superhet, in a tough handy case — fits your palm. Assembled by hand. Earphone included. Uses 1.5V battery (cheaper than usual ones!) You couldn't buy the parts for our price. In fact we've sold a few to people just for the parts!! A real knockout at $5.99 (P&P 75c) YES IT DOES WORK — I tried one out in my car all over Sydney and pulled in all local stations easily.

Have you got a CAT?

Dick's catalogue isn't just a price list. In fact it's hardly a catalogue since it contains so much useful information. Of the 64 pages over 20 are pure information. Like the IC data pages, 6 cover linears and digitals with suggested circuits too. Test gear, tools, amateur info. Pages on SCRS and triacs, books etc etc. Plus popular 50 cent discount vouchers and simple mail order form.

The big news is that the catalogue is FREE, just send the coupon below. YES a 64 page manual, 50 cent vouchers all for nothing. Send for yours now!

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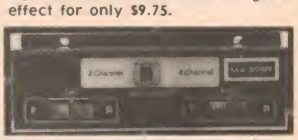
Yes you don't need an extra amplifier when you fit the Quadronec Unit. This four channel decoder operates AFTER your amp. Simply buy two extra speakers and you can get the full quad-effect! Has front rear balance and impact controls. Double stereo. Headphone connector. Get quadronised for only $75 (P&P $1.50).

Realistic Price Crash

The popular Realistic receiver has benefited from tariff cuts. Over 30 semiconductors. Tunes SW C-W SSB AM Broadcast bands etc from 600kHz to 30MHz. Latest stock has CASCODE FET RF Amp. Variable BFO etc. Mains or Battery operation. Interesting manual tells you all about Short Wave Listening, so ideal beginners set and we give you FREE Australian Amateur Callsign book. Come in and hear one in our demo. lab you'll buy at only $185 (P&P $3.00).

Car Radio Quad Adaptor

The QD77 is a neat looking little unit to give the quad effect in your car. All you need is a couple of extra speakers. Separate Left and Right controls and 2 4 channel switch. Full instructions. Gives a great effect for only $9.75.



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Electronic diagnosis for drug overdose victims

Electronic equipment and technology is destined to play an increasingly important role in the diagnosis and treatment of medical conditions. This short article describes a computerised technique in which electronic equipment is used to aid drug overdose victims.

by GEORGE E. TOLES

Physicians in Boston, Massachusetts, confronted with a comatose patient (that is a patient who is unconscious or in a stupor) whom they suspect is suffering from a drug overdose, can have the patient's body fluids examined by a computerised drug analysis system at the Massachusetts Institute of Technology (MIT). The new technique can be used to automatically determine which of several hundred drugs the patient may have ingested.

The computer can be used to identify more than 400 drugs, drug metabolites (breakdown products of drugs in the body), natural body substances, and contaminants. Included in this group are such drugs as tranquilisers, amphetamines, barbiturates, and other abused drugs such as methaqualone (known commercially as Sopor or Quaalude). The MIT researchers stress, however, that they are not particularly concerned with detecting alcohol, heroin, or marijuana. Patients who are comatose as a result of overdoses of this type may be diagnosed by other means, such as the evidence of bottles or needle marks.

The computer system was originally developed by Dr Klaus Biemann, Professor of Chemistry at MIT, to search for organic compounds in lunar soil retrieved by the Apollo moon missions. A miniaturised version of the system will journey to Mars in 1975 to search for organic compounds there.

The system consists of a chemical separatory device, known as a gas chromatograph, which is attached to an analytical instrument called a mass spectrometer. This, in turn, is linked to a computer programmed to record and sift through the analytical data.

When confronted with a comatose patient, an area physician first of all notifies the clinic at MIT. He then sends samples of the patient's blood, urine, gastric juices and other body fluids to the clinic via messenger. The organic constituents of each sample are then extracted, and injected into the gas chromatograph.

Inside the gas chromatograph, the extract is flushed through a long, thin tube packed with a powder on which a polymeric liquid is adsorbed. The individual substances in the extract separate from one another according to their differing solubilities in the adsorbed liquid. Each kind of molecule, whether drug, metabolite or natural body substance emerges separately from the tube.

As the separate molecules escape from the tubing, they enter the mass spectrometer. This instrument breaks up the molecules into ionised fragments and sorts them according to how they behave in a magnetic field. The array of fragments represents a molecular "fingerprint" which is unique for each substance.

Finally, the computer scans these molecular arrays and then searches in its memory for a matching array. A single scan takes about 4 seconds. The name of each substance is printed out as it is identified. When the extract has been completely analysed, the computer lists the body fluid constituents in order of concentration. "Usually the drug which is the most highly concentrated substance caused the overdose," Dr Biemann said. "After completing the analysis we telephone the physician and inform him of our findings so he can take remedial action."

According to Dr Biemann, the system has reduced waiting time for drug analyses from two days to two hours, including transportation of the sample.

"In most cases this has been quite satisfactory for the physicians, because they cannot begin administering counteractive measures to comatose patients until emergency measures are taken," Dr Biemann said. "These usually take about two hours. The results are also much more reliable than those obtainable by usual laboratory techniques."

Dr Catherine Costello prepares to inject a blood sample into the computerised analysis system. The gas chromatograph is situated to the left of the picture, whilst the centre units comprise the mass spectrometer.

Home talkies for all with Kodak's new super-8 cameras

A new range of super-8 movie cameras being released by Kodak will now make it possible for anyone to shoot high quality lip-sync "talkies", easily and at low cost. To go with the cameras, Kodak are marketing pre-striped colour film in modified super-8 drop-in cartridges, and are also releasing a new range of low cost sound projectors.

by JAMIESON ROWE

Almost everywhere in the world, the name "Kodak" is practically synonymous with photography and motion pictures. And not without good reason. Kodak are by far the biggest manufacturer of photographic film and paper, a major processor, and one of the biggest makers of cameras, projectors and associated equipment.

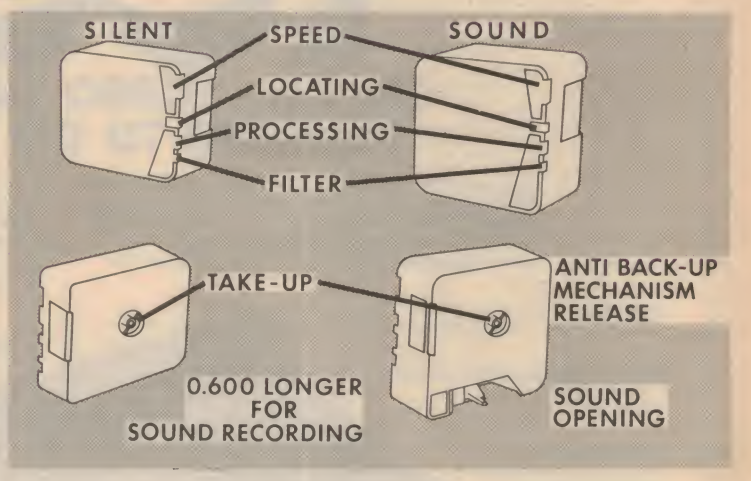
It's not just their size that has made them famous, though. The company has been in the photographic business ever since it became a real business. In fact it can lay claim to having started the photographic industry: company founder George Eastman invented cellulose nitrate film back in 1889, and it was this invention which made photography and motion pictures really practicable.

Since that time, Kodak has provided many of the important milestones in the evolution of photography. Always a company to plough considerable funds back into research and development, it has consistently been able to set the pace of the industry by making technological breakthroughs. Nowhere has this been more apparent than in the area of home movies.

Keen amateurs had made movies right from the development of moving pictures in 1890. But by and large they had to use the same costly equipment and inflammable 35mm film used at that time by professionals, and this limited the appeal considerably. An attempt was made to use 17.5mm film, made by slitting 35mm stock, but this offered few advantages and soon faded into oblivion. A system developed by the Pathe company in France using 28mm safety film suffered a similar fate.

It was only when Kodak launched the 16mm film gauge in 1923 that home movies became a practical reality for most would-be enthusiasts. In that year they announced their famous hand-cranked Cine-Kodak Model A camera and Kodascope projector, following them up in 1924 with a spring driven camera.

The thoroughgoing marketing policy which has become a characteristic of the company was evident even at this early stage. Besides releasing cameras, projectors and film, they set up 16mm reversal film processing plants not only at their main plant in Rochester, New York, but also in Chicago, San Francisco, Toronto and London. And at the same time they also set up Kodascope film libraries, making



At top left is the Kodak model A 16mm camera, 1923 vintage, while at top right is the new Ektasound 140 super-8 sound camera in use. Above left is the Ektasound 245 sound projector, which uses a novel vertical format. The diagram at above right compares the silent and sound camera cartridges.

16mm prints of commercial feature films available to the amateur for rent or purchase.

In the fifty years since then Kodak has introduced most of the important developments in the home movie field. In 1932 they announced the original 8mm film gauge, with the camera using double-perforated 16mm stock which was slit after processing. This made it possible for amateurs to make movies for less than half the previous cost.

1935 saw the introduction of the first Kodachrome colour film in 16mm, and the year later it was made available in 8mm. In 1937 they released the first 16mm Kodascope sound projector.

In 1951 they brought the simplicity and economy of their "Brownie" snapshot cameras to movies, with a very low priced Brownie 8mm camera. This was followed in 1952 by the matching Brownie projector.

The improved Kodachrome II colour film was released in 1961, offering 2½ times the speed of the original film together with improved definition and colour rendition.

And in 1965 came a particularly important Kodak development: the introduction of the "super-8" film format, offering 1½ times the image area per frame compared with the original 8mm format. This gave considerably improved definition and colour rendition, yet still retained the low cost associated with a narrow gauge. With the new format, Kodak also introduced a drop-in cartridge system for camera loading, giving greatly improved user convenience.

The many advantages of the super-8 system made it an instant success, and virtually all manufacturers of cameras and projectors for the original 8mm format obtained licences from Kodak to make equipment for the super-8 system. Largely as a result of the super-8 development, home movies have increased in popularity almost astronomically since 1965.

Not only this, but super-8 movies have become widely used in industry for training and promotion. Large motor manufacturers in the US such as General Motors are now using super-8 films to train dealers throughout the country when each new model vehicle is released.

The high quality offered by super-8 has also made it attractive to professional film-makers and TV broadcasters. A number of TV stations in the US have now switched over entirely to super-8 colour for their news work.

Until now, however, 8mm home movies have been largely silent. Technically it has been possible to provide films with sound, but the equipment and techniques required have been sufficiently specialised to limit sound mainly to the advanced enthusiast and to commercial applications.

Happily this situation is about to change, again as the result of a new Kodak development: the release of a new family of "Ektasound" cameras, featuring a complete self-contained magnetic stripe recording system. And to suit the new cameras Kodak have produced a modified version of the super-8 camera cartridge, providing pre-striped film.

The equipment, and more importantly, the film will now be available to allow anyone to shoot lip-sync sound movies simply, conveniently and at low cost.

As part of the new Ektasound system Kodak are also releasing a new series of sound projectors. These use a radical new "vertical tape deck" format which features simplified threading, projection from either front or rear of the case, and a price significantly lower than most existing sound projectors.

There are two cameras in the new Ektasound range, the model 130 with a fixed

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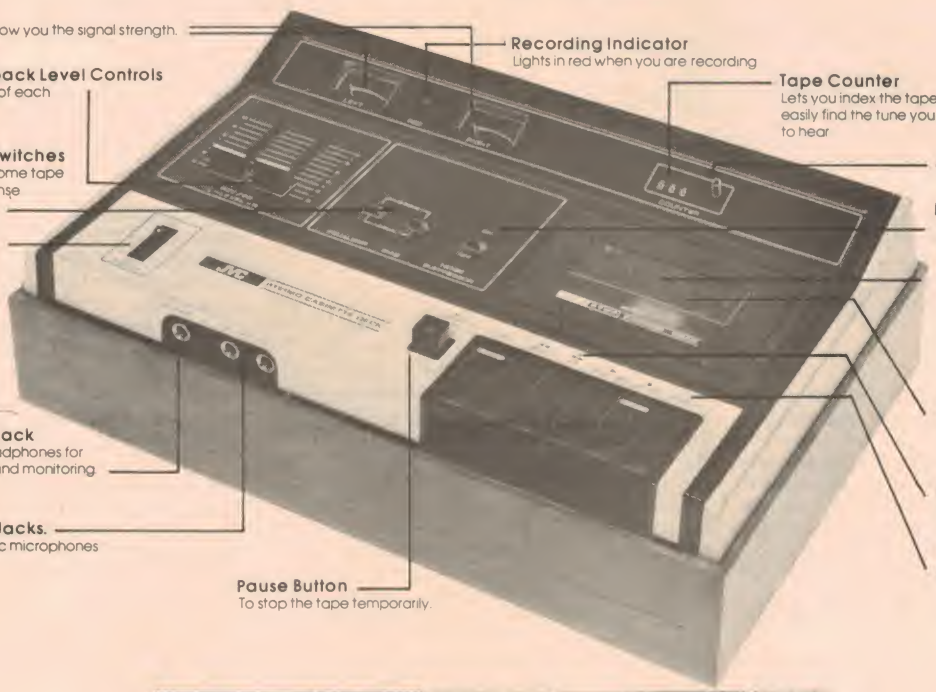

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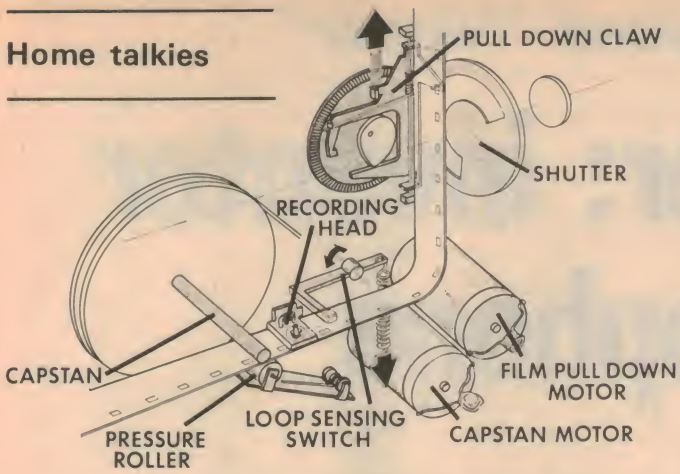
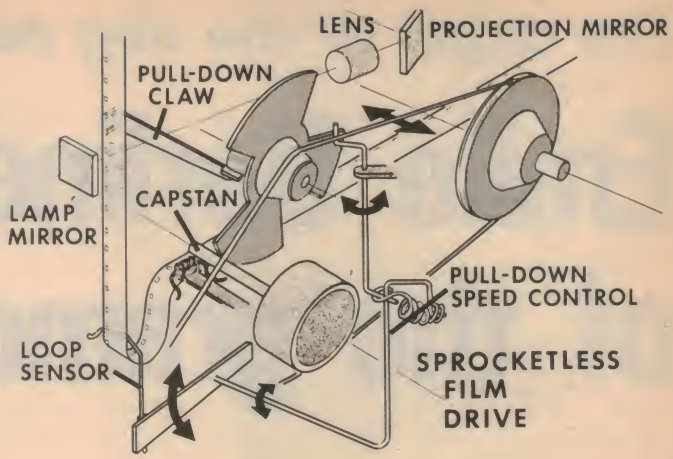
Home talkies



Basic components of the new Ektasound 130 and 140 super-8 sound cameras. Main film drive is via a capstan and pinch roller, tape recorder style.



As in the cameras, film drive in the Ektasound 235 and 245 projectors is via a capstan, with a loop sensing system used to synchronise pulldown rate.

focal length lens and the model 140 with a focussing 9-21mm manual zoom lens. Both have fully automatic exposure control, using a CdS cell and a double-vane aperture.

The optics of the cameras are adapted from the company's popular "XL" silent cameras, and feature the same f / 1.2 lens and 230-degree shutter opening to permit maximum sensitivity. Using the fast Ektachrome 160 film, the cameras will take well-exposed movies using the light from a single candle.

Both Ektachrome 160 and Kodachrome II films will be available in pre-striped form in the new Ektasound cartridges, giving the user a choice of either high speed or extreme definition.

The new cameras incorporate a sophisticated sound recording channel. The solid-state recording amplifier is fitted with automatic gain control (AGC), obviating the need for the user to adjust recording level. An indicator lamp, visible in the viewfinder, flickers red to signal when recording is correctly taking place. Failure of the lamp to light indicates one of a number of faults, such as insufficient sound level, disconnection of the microphone, low battery, or inadvertent use of silent film.

Two drive motors are used in the cameras, one for the sound drive and the other for the picture taking mechanism. The sound drive motor is electrically governed to establish the correct film speed of 18fps. It drives the film via a capstan and pinch roller, like a tape recorder. The picture mechanism drive is synchronised with the sound drive by means of a loop sensing switch controlling the current fed to the second motor.

Power for the two motors is provided by six AA-size alkaline cells. The Ektasound cameras will operate with normal silent cartridges as well as with sound cartridges, and in this case the capstan drive motor and recording amplifier are inoperative. The filming speed for silent cartridges is 20fps rather than the usual 18fps.

The recording amplifier in the cameras includes 3 integrated circuits and is powered by a separate 9V alkaline transistor radio battery. Both cameras are supplied complete with an omnidirectional microphone fitted with a 12-foot cord, microphone stand, wrist strap, rubber viewfinder eyecap and an instruction manual. Optional accessories include a carrying case, a microphone extension cable and an alternative directional microphone.

As with the cameras, there are two projector models in the new Ektasound series. One, the model 235, is a replay-only machine; the other offers recording as well, and is known as the model 245. Both use the same vertical "tape deck" format, and feature a wooden cabinet with smoke-tinted plastic dust cover which remains in place during projection.

All operator controls are on the front of the machines, with the basic functions controlled by means of a lever moving in an "H" gating format. A unique dual-position mirror positioned in front of the projection lens allows the image to be projected either from the front or rear of the unit. The projectors can thus be used either conventionally, or from a location such as a bookshelf.

Both projectors feature fast forward and rewind facilities, which are rarely found on home movie projectors. They have 400-foot spool capacity, and will operate at either 18 or 24fps. The light source is a 30V-80W DFE type lamp.

Film drive in the projectors is sprocketless, and like the Ektasound cameras is closer to tape recorder practice than to conventional projector mechanics.

For professional use, the Supermatic 200 sound camera takes 200-foot cartridges of either sound or silent film. Developed from the Ektasound models, it also runs at either 18 or 24fps.

It is presumably this rather novel approach which has enabled Kodak to produce machines offering high performance at a very attractive price.

There is a single motor, which drives the film via a capstan and pinch roller at the sound head. A loop sensing device is then used as before to synchronise the intermittent claw and shutter.

In this case, the loop sensing device is a mechanical lever system which achieves its synchronisation action by moving the main projector drive belt across a conical pulley on the intermittent drive shaft.

Overall, the projectors are very quiet in operation, due to the absence of gears and sprockets.

Power output of the audio amplifier built into the projectors is 3 watts, quite sufficient for most domestic situations. Included in the projector case is a 4-inch inbuilt loudspeaker, but a larger auxiliary speaker is available as an optional extra.

Both the cameras and the projectors in the Ektasound range use the standard 18-frame separation between picture and sound, with the sound leading the picture. Thus they are compatible with existing super-8 sound films and projectors.

The Ektasound 130 and 140 cameras will be available in Australia shortly at suggested retail prices of $245 and $340 respectively, including carrying case and batteries.

Similarly the Ektasound 235 and 245 projectors will shortly become available, at suggested retail prices of approximately $300 and $400 respectively.

Ektachrome 160 and Kodachrome II sound film cartridges are already available, with suggested retail prices of $7.10 (excluding processing) and $9.05 (including processing by Kodak) respectively.

Toward the end of the year, Kodak will also be releasing a modified version of the Ektasound cameras for professional use. This is the Supermatic 200 sound camera, which has all of the features of the Ektasound 140 together with the ability to operate at either 18 or 24fps.

The Supermatic 200 camera will also take a special jumbo-sized 200-foot film cartridge in addition to the normal 50-foot cartridge. The larger cartridge protrudes from the top of the camera through a slot, the slot being covered by a spring flap when

(Continued on P75)

The origin of the dog named "Nipper"

Emile Berliner: inventor of the gramophone

It is all too easy for a man to contribute something of importance to society, and yet achieve little recognition for it. Such is the case with Emile Berliner. The microphone, the disc record and the gramophone, some of today's record industry giants, and the worldwide fame of the dog named Nipper all owe their origins to this little-known inventor and audio pioneer.

by OLIVER BERLINER

My father's gift for recollection is responsible for my lifetime illusion that I knew my grandfather, Emile Berliner, who invented the microphone and gramophone — that is, as the disc record — and the first practical system for mass producing it. It is a fantasy that is very real to me even though Gran'pa died when I was but two months old. Like the son who had heard so many details of his parents' wedding that he knows he must have attended, I feel I know this formal-looking gentleman of middle height whose German-accented English and pince-nez imparted a tutorial mien. He affected a stiff starched collar and string bow tie all his life, the natural accoutrements of any European American who had made his mark in life and upon society.

Emil (he added the final "e" in America) Berliner was born in Hanover, Germany, on May 20, 1851, and emigrated to a new life in the New World via the "Hammonia" on April 27, 1870, at the age of nineteen. He had little in his pockets and scant knowledge of English — especially as articulated in New York where the ship docked. Fascinated by electricity, he spent his evenings studying at Cooper Union, supporting himself as a dry goods clerk.

An exposition in Philadelphia was one of the highlights of US centennial celebrations held in 1876. There an obscure Nova Scotia-born Scot by the name of Alexander Graham Bell was experiencing great disappointment at the lack of public interest in his invention, which he called the telephone. Then came the day the president of Brazil, though weary from wandering through the endless exhibits, insisted to his aides that he be permitted to examine the telephone. His exclamation "My God, it talks!", and the ensuing hullaballoo, got Bell the attention he had been praying for. The telephone was launched.

The instantaneous acceptance of telephony kindled the interest of other inventors of the era, most famous of whom was Thomas Alva Edison. He recognised that the major defect in the telephone was what Bell referred to as the transmitter — the piece into which one spoke — since it could transmit only short distances. Edison was not alone. Emile Berliner already was attempting to build an improved telephone that would eliminate this inherent flaw.

On April 14, 1877, when he was not yet twenty-six years old, Emile Berliner filed with the patent office his "caveat" — a device by which the patent office allowed inventors to stake out claims to the areas they were working on in advance of a formal patent application — covering a battery-operated loose-contact transmitter. It used a principle that passed the limits of scientific credibility at the time — electrical contacts that don't actually make contact yet carry the necessary current.

Being penniless, Emile Berliner prepared his own caveat, but its accuracy and completeness permitted it to withstand subsequent legal attacks from powerful forces.

Later the Bell System purchased my grandfather's invention, but misfortune was to strike the Bell-Berliner interests. The prestigious Western Union Telegraph Company, relying on the microphone patent

Above, an early model of Emile Berliner's invention, the gramophone. This hand-cranked machine was the first to use discs. At right is one of the first records pressed in the Deutsche Grammophon factory. Recordings were made on one side of the disc only.

of Thomas Edison, sued. But by 1879 Western Union conceded the validity of the Bell-Berliner patents on advice of legal and technical counsel and abandoned its telephone activities, paving the way for the Bell System to become the giant it is today.

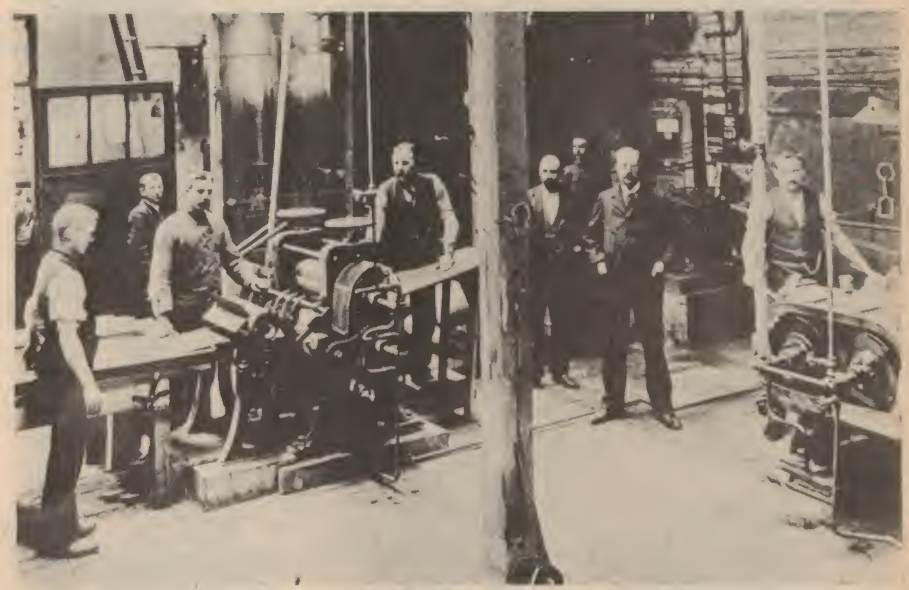
Ever wonder what a man gets for an invention of this magnitude? Well, my father couldn't tell me for certain. American sources say he got $50,000 from Bell System. The Canadians say he got $100,000, which was pretty big money in 1878. Deutsche Grammophon, which Gran'pa later founded, insists he received $75,000.

By the time my grandfather had reached an agreement with the Bell people, Thomas Edison was introducing a device which he called the phonograph. The cylinder phonograph's rise to popularity was meteoric, and eventually the theatrical stars of the day flocked to Edison's studio to make recordings. But they were dismayed when they learned that the mediocre technical quality of those early cylinder masters was even further diluted by the fact that there was no mass duplication. Artists were compelled to make innumerable cylinders of the same melodies in order to satisfy the demand for the more popular numbers.

Realising that there had to be a way to mass produce recordings and to make the quality of the copies equal to that of the originals, my grandfather came up with the flat disc record and player in 1887, and applied for a patent on September 26. He called the device the gramophone, from the Latin meaning "sound of letters," more or less. Gran'pa established the Berliner Gramophone Company in Philadelphia, and the record business as we know it was launched. Just as with the microphone, my grandfather's disc — though much improved today — is basically as he conceived it. Unchanged too is his method of pressing millions of copies from a single master. Here for the first time was truly low-cost professional entertainment for the home, which as Gran'pa observed, "... taught the ploughboy to whistle grand opera."

Again, the awesome spectre of Thomas Edison loomed on Emile Berliner's horizon. Edison sued Gran'pa, claiming that the disc was stolen from the cylinder and obtained an injunction prohibiting my grandfather from making gramophones and records. The court, however, eventually declared that the disc did not infringe. (In 1878 Edison had experimented with a disc version of his tinfoil phonograph, but the experiments were not successful.) Emile Berliner was vindicated, and eventually the cylinder was relegated to office dictation purposes.

However, Edison's strategy hurt Gran'pa financially while the injunction was in effect. But he had a strategy of his own. Though he was enjoined from manufacturing there was nothing to prevent him from licensing someone else to make his products. So he arranged for a machinist across the Delaware River in Camden, New Jersey, to produce discs and players. Eldridge Johnson had been making clockwork spring motors to power the gramophones, and now he was to make everything. By the time of Gran'pa's court victory and simultaneous financial ruin, Johnson was getting rich. The Berliner Gramophone Company never surfaced in this country again though the Canadian company continued under that name. Instead, Johnson



Above, Emile Berliner at work on his records in later life. The photograph below was taken in 1898 and depicts the birthplace of the the Deutsche Grammophon Gesellschaft — the corner of a telephone factory in Knie Strasse.

acquired the Berliner Gramophone assets and a partner — Emile Berliner. To celebrate the court victory, Johnson called his new company the Victor Talking Machine Company.

In 1900, prior to his tribulations, my grandfather had been visiting his British affiliate, then known as The Gramophone Co Ltd. Today it's the behemoth Electric & Musical Industries (EMI). In May of 1899, British Gramophone had been paid a visit by an obscure artist and photographer named Francis Barraud, who'd painted an amusing portrait of his dog listening to a cylinder phonograph. He wanted The Gramophone Company to supply him with a player so that he could substitute its shiny brass horn for the black japanned horn of the Edison machine. At the insistence of Barry Owen, the Company's American-born managing director, he borrowed — and painted in — not only the horn but the player and a Gramophone record as well. Later that year Owen bought the picture and its copyright for £100. Gran'pa saw reproductions of the painting in British record shops. Realising its true promotional potential (no one-track-minded inventor-type he) my grandfather returned to the USA and on July 10, 1900, "His Master's Voice" was officially born as a trademark.

Barraud went on to paint many copies of his original art. Nipper, the dog, who had passed away in 1895, was given belated honours at a mulberry tree under which he was already buried on Eden Street, Kingston-on-Thames. Though excavation failed to confirm the historic site, Nipper's real memorial surely is as part of one of the world's most famous trademarks.

The original hangs in the EMI board room, insured for a million pounds or so. If you stand at the proper angle you can see, beneath the gramophone, the outline of the

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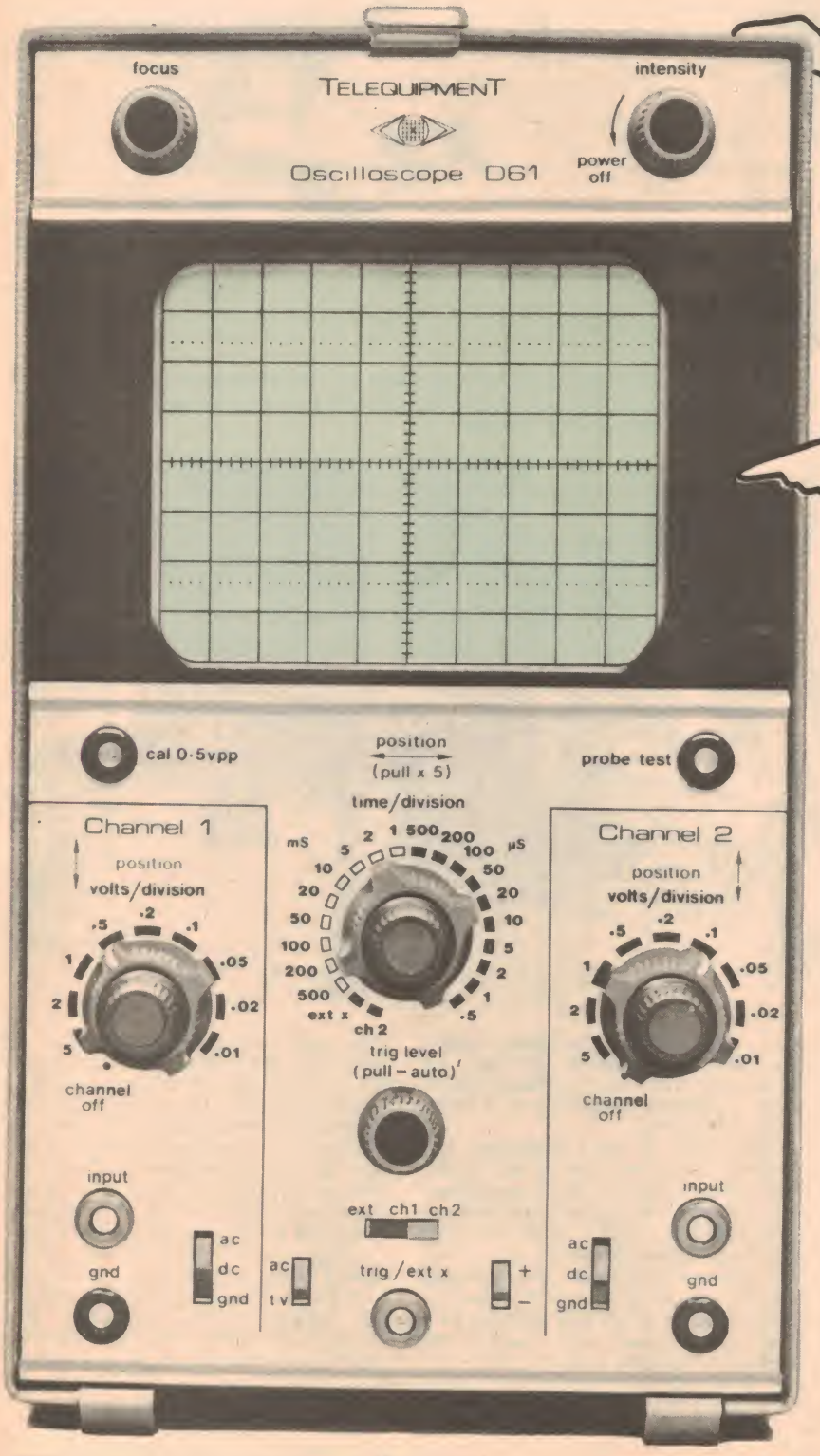

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Emile Berliner: audio pioneer

A visit from an English executive (at right, in top hat) was the occasion for this photograph of the entire Deutsche Grammophon factory staff. The photo was taken soon after the firm's establishment in 1898.

old cylinder machine — or phonograph. The primary reason why Edison erroneously gets credit for the disc is that in France and the Americas people mistakenly refer to disc players as phonograph, whereas the British and the rest of the world correctly call them by Gran'pa's word: gramophone.

Public acceptance of the disc was good. But at first major artists were less than enthusiastic. It was not until five years after its advent that they were to begin making discs. An up-and-coming Italian tenor, Enrico Caruso, agreed to make some in 1902. He and the gramophone then moved from one triumph to another, and soon almost every major artist of the era was represented on disc.

Although British Gramophone had first access to the "His Master's Voice" trademark, it took them eight years of featuring their "recording angel" (used by Angel Records today) before they bowed to the weight of public opinion and adopted Nipper. On the other hand, Gran'pa took out a US patent on the trademark in 1900 and began using it at once. Deutsche Grammophon, which had been showing Nipper on its issues for the German domestic market — though all ties with the English and American companies had been severed by World War I — sold the trademark to competitor Electrola (controlled by EMI) in 1949 in part to settle a dispute over ownership of the German rights.

By that time another calamity had struck the record industry (and Emile Berliner) — radio, followed by the fantastic costs of conversion to electrical recording and the stock market crash in 1929. Radio brought forth another immigrant lad — this one from Russia. The sinking of the "Titanic" on her maiden voyage from England to New York in 1912 was to play a major role in this young man's success, and in the record industry.

Young David Sarnoff, a night-time wireless operator for the Marconi Company, was the only man on land to receive the "Titanic's" distress signals. The fame that he won for his part in the rescue operation led eventually to a managership in a then fledgling company called Radio Corporation of America, a patent-pool venture championed by Assistant Secretary of the Navy, Franklin Roosevelt, just after World War I and participated in by electrical giants Westinghouse, General Electric, and AT&T.

Trouble was, both Davie and RCA were short on radio manufacturing know-how, reputation, distribution, and even plant facilities. But they were long on nerve, money, and Wall Street connections. And there before them was the sleeping giant — Victor Records — with its prestige, trademark, retail outlets, factories, skill, and showmanship. In 1929, RCA acquired the Victor Talking Machine Company of the United States and Canada, taking with them the North and South American rights to the terrier named Nipper.

Gran'pa had years earlier gone into retirement, the recipient of numerous awards and accolades. A modest man, however, he let Edison have the glory, although he later admitted that his modesty had been a mistake.

On August 3, 1929, shortly after RCA acquired Victor, the National Broadcasting Company observed moments of silence over the entire network to mark the passing of Emile Berliner. He left behind a remarkable collection of inventions — the microphone, the disc record, and the gramophone — and was directly responsible for the organisation of the companies that led to many of today's giants in the record industry.

Reprinted from "High Fidelity," by arrangement.

How safe ARE atomic power stations?

Almost since their conception, atomic power stations have prompted a raging debate on their various safety aspects. This debate has been made all the more critical, and at the same time has not been eased, by the burgeoning world energy crisis. This article discusses the safety problems of atomic power stations in the United States.

by EDWARD EDELSON

Some 30 atomic power stations with a generating capacity of 15,500 megawatts of electricity are already in operation in the United States. A further 135 stations are currently under construction or in the planning stages. The Atomic Energy Commission (AEC) projects that by 1985 atomic power stations will provide 10 per cent of the US energy requirements. By the year 2000, this figure will be closer to 30 per cent.

However, the road to these promising aspects of atomic energy is by no means clear. Serious scientific and technical questions have been raised about the safety aspects of nuclear generating plants; questions that must be answered if atomic energy is to provide the future energy requirements of the US.

Critics say that the AEC has not done enough to ensure the basic safety of these plants, and that there is disturbing evidence indicating that the emergency safety systems designed to avoid major accidents might not work when they are needed. Such prominent figures as Ralph Nader and Senator Mike Gravel of Alaska say that the evidence of laxity by the AEC, the builders of nuclear plants, and the electric utilities is jarring enough to warrant a moratorium on construction of nuclear plants.

The pro-nuclear reply is that quality control is good enough, that the emergency systems will work if they are needed, and that the fears expressed by critics are far out of proportion to the real risks. If the worst fears about the safety of today's nuclear plants are true, then the US could face an energy crisis of major proportions.

The reason for this is that geothermal power, solar power, fusion power — no matter how promising — are not expected to fill our energy gap for decades.

How justified are these safety fears? In two words, nobody knows. At this stage of the game, it's all a matter of educated guesses. Since the reactors being built today are two and three times bigger than any in the past, there is no solid data on long-term operating experience. Since no emergency system for such a reactor has ever had to meet a fully-fledged crisis, no one can say for sure what would happen.

Nevertheless, each side has scored its points. Critics have cited evidence that some safety experts within the AEC have been deeply unhappy with the safety research program — charges that the AEC has tacitly admitted by internal shakeups and by moves to tighten the standards it once said were perfectly adequate. On the other hand, AEC regulatory officials stolidly point out that whatever its deficiencies, the safety program thus far has prevented any major accident (although they acknowledge that they cannot ensure that the same thing will be true when many more reactors are operating for much longer periods).

To understand the dimensions of the debate, you need a working knowledge of the innards of what physicist Ralph Lapp calls "the most complex large technological apparatus we have ever built" — the modern nuclear generating plant.

To oversimplify grossly, these plants have two key ingredients: fuel to produce heat and coolant to transfer heat. The fuel, of course, is uranium. The coolant for almost all nuclear plants built in the United States is ordinary water — "light water" in industry jargon. (A high-temperature gas-cooled reactor is also available, but relatively few have been sold.)

There are two kinds of light-water reactors. One type, built by Westinghouse, Babcock & Wilcox, and Combustion Engineering, is called a pressurised water reactor (PWR); the other type, built by General Electric, is a boiling water reactor (BWR).

Both BWR and PWR use the same kind of fuel: pellets of uranium dioxide, containing about three per cent U-235, formed in a hydraulic press and ground to close tolerances. Each pellet is a cylinder about a half-inch in diameter and a half-inch long.

These pellets are inserted in a long seamless tube, made of stainless steel in the earlier days, but now made of an alloy called zircalloy. Each fuel rod is about 12 feet long with a 0.003-inch gap between the pellet and the cladding. A light-water reactor may contain almost 40,000 of these rods, with about 100 tons of uranium dioxide.

That may seem like a frightening amount — enough U-235 to make 100 atomic bombs — but no one is worried about a nuclear plant exploding like a bomb. It can't happen because the three per cent U-235 used in nuclear fuel doesn't do what the nearly pure U-235 in a bomb can do. Even the most severe critics of nuclear safety dismiss that possibility out of hand.

What they're worried about is the possibility that the nuclear fuel might get hot enough to melt and escape its containment, thus releasing vast amounts of deadly radiation into the atmosphere. That danger involves the other key ingredient of a reactor, the water that acts as a coolant.

In both BWR and PWR, the essential activity is the same: heat produced by fissioning uranium turns water into steam, which then turns a turbine to produce electricity.

In the PWR, this is a two-step process. The core of the reactor is one big bundle of fuel rods. Water comes in from the top and makes a U-turn upward through the fuel elements. The water is held at a pressure of 2,250 pounds per square inch, which means it can be heated to approximately 600 degrees F without turning to steam. (The surface temperature of the fuel rods is about 600 degrees, although the centre of the pellets may reach a near-molten state at 4,100 degrees F.) This pressurised water is then piped into a steam generator, where its heat is transferred to a secondary loop. Water in this second loop is turned into steam, which turns the generator.

The boiling water reactor uses a one-step system. Water at 1,000 pounds per square inch is piped into the core, where fuel rods are collected in several hundred bundles. The water flows in channels between the bundles, is heated to 545 degrees F, turns into steam, and flows directly to the turbine. It is then condensed to start the cycle again.

In the safety debate, the key fact about the water in both BWR and PWR is that it has a double function. Not only does it transfer heat to the turbine, but it is also used as a coolant, keeping the core bundles of fuel elements at the desired temperatures. The nightmare that everyone fears is a LOCA — "loss of coolant accident," in which the reactor core suddenly loses its water and quickly becomes catastrophically overheated.

The scenario for a LOCA has different outcomes for AEC people and for their critics. But the story has the same starting point: what the experts call a "double-ended guillotine break" of the largest pipe in the coolant loop — in other words, a complete snap that severs the pipe completely, sending water gushing out relentlessly at high pressure.

The AEC claims that after such a break, the emergency core-cooling system (ECCS) would work by flooding the core with emergency coolant. The agency's critics claim that the ECCS would fail because the coolant would never reach the core.

If the critics are right, this is what would happen:

The core temperature would rapidly rise to a point where, at about 2,700 degrees F, the chemical reaction of zircalloy and steam changes; instead of being cooled by the steam, the alloy is heated by a chemical reaction that liberates hydrogen, creating additional heat to be removed. The core gets hotter.

In a matter of minutes, the core has reached a temperature over 4,000 degrees, and it melts, forming a glowing, radioactive ball weighing 100 tons. To contain the high pressure of the core, and for safety's sake, the nuclear innards of the reactor are contained in a huge pressure vessel of carbon steel, six to eight inches thick; it is calculated that the molten core will melt through this container in about half an hour. The cooling system is contained in a structure of reinforced concrete, perhaps three and a half feet thick, with a steel liner and a nine-foot-thick concrete slab at its base; the molten core will break through this slab in about a day.

No one really knows what the ultimate damage would be. Much of the radio-active fission products in the core are gaseous isotopes — xenon, krypton, iodine — and vast amounts will be liberated. Solid isotopes such as strontium-90 could be splattered out of the plant. The core itself, it is assumed, will eventually form a molten glob and sink beneath the earth's surface.

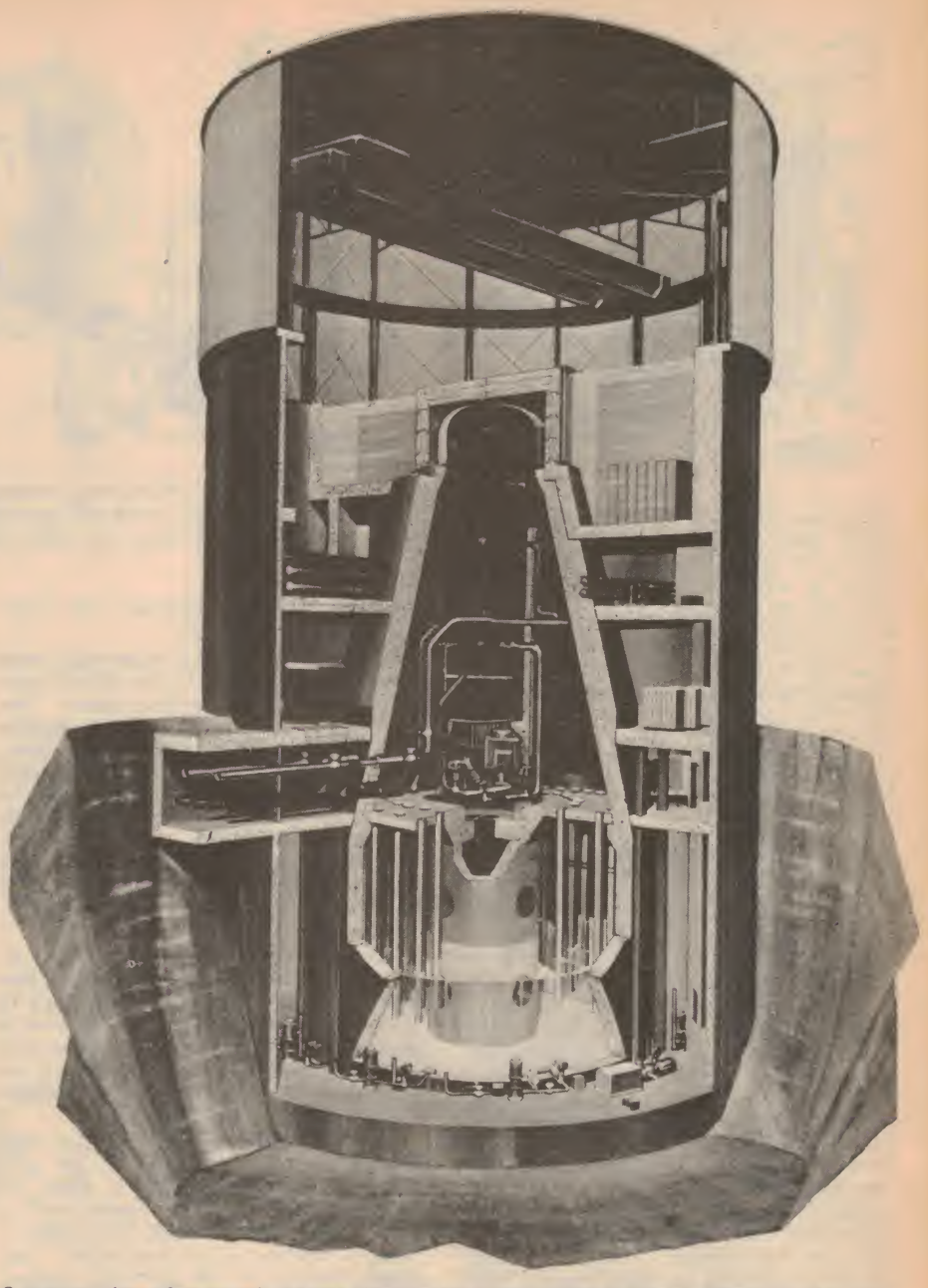
Can it ever happen? The critics say such a scenario is uncomfortably probable. The AEC says disaster is highly improbable for two reasons: first, the odds of a double-ended guillotine break ever occurring are extremely small; and second, the odds that the ECCS will work are high.

The ECCS question began to heat up as early as 1965, when utilities first presented proposals for building large, 1,000-megawatt nuclear generating plants. Concerned about the emergency system designed for these plants — systems that everyone now agrees were more or less tacked on as an afterthought — the AEC appointed an expert committee to study the subject. The committee reported in 1967 that the effectiveness of the safety systems was far from assured, and that a lot more work needed to be done.

AEC told Oak Ridge National Laboratory to start some studies, and industry was given some contracts to conduct tests and to run computer models of ECCS operation.

The closest thing proposed to a true test of an ECCS is a facility called LOFT (for "loss of fluid test") at the National Reactor Testing Station in Idaho. LOFT originally was scheduled to go operational in 1966, but a lack of funds and insistence that it be built to the highest standards has held back this 1/50 scale reactor distressingly. The first LOCA tests were due to begin early this year, significant data will not emerge until 1975.

Meanwhile, the AEC and industry safety researchers have used computer models and small-scale tests. Results have not been happy. Perhaps the most disturbing event occurred in the fall of 1970, when the Aerojet Nuclear Company, a major safety contractor, ran a series of tests on a tiny, nine-inch-diameter model reactor core to study various aspects of coolant loss. In that test, the company reported, "essentially no emergency core coolant reached the core;" the injected water simply ran out of the break in the coolant pipe.



Cut-away view of an atomic reactor showing the core and the fuel rods. The base of reactor is set into reinforced concrete with a steel liner.

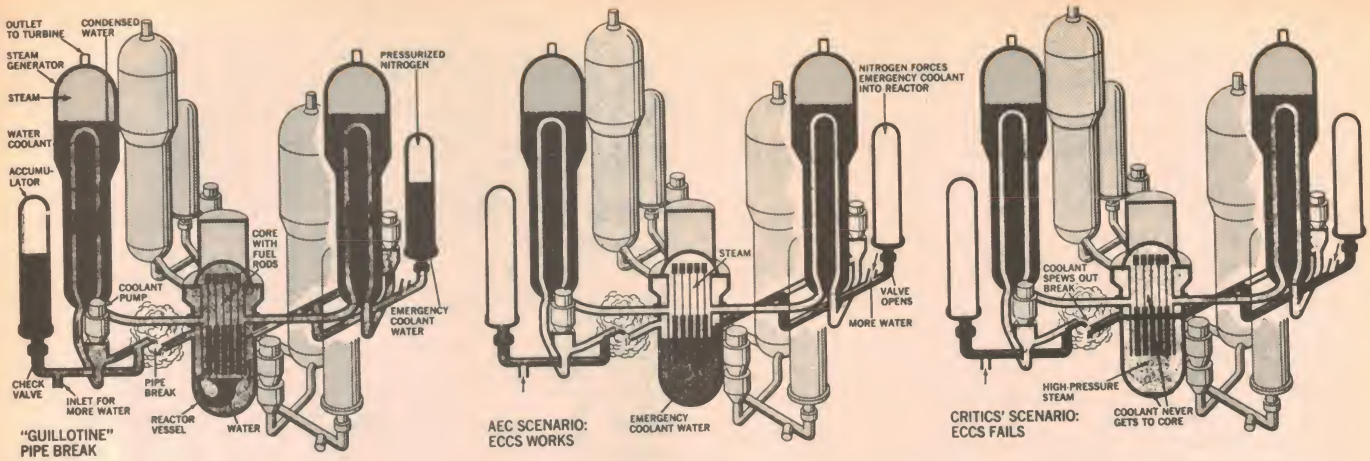
In December 1971, William B. Cottrell, director of nuclear safety programs at Oak Ridge, and other researchers there, wrote headquarters a letter saying that there were "wide gaps in our knowledge." Earlier, Morris Rosen and Robert J. Colmar, two experts on the regulatory staff, had analysed a Westinghouse computer model named SATAN, which predicted that the ECCS would work. The two men identified several errors in the program, and called the overall justification of the model into question.

The AEC's first line of defence is its quality-assurance program — a program designed to ensure that as little as possible goes wrong in any nuclear plant. Regulatory officials say that no conventional power plant has ever been built to the standards of a nuclear facility.

"We completely radiograph all welds," says Edson Case, Deputy Director of Licensing for the AEC. "We have significantly greater requirements on the pedigree of the pipe and the material from which it is made . . . In service, equipment is inspected by ultrasonic or radio-graphic means, on a continuing basis. Over a 10-year period, we'll look at everything in the plant. Probability of a failure of a nuclear system vs. a conventional system — in the piping — is a factor of 100 less."

The unit of measurement used in calculating these probabilities is the reactor-year — one reactor in operation for one year. To put that in context, all the commercial light-water reactors now operating in the United States have accumulated 150 reactor-years of experience. By the end of the century, the US may have as many as 1,000 commercial nuclear plants, which means 1000 reactor-years of experience annually.

By analysing data on pipe failures in conventional power plants, the AEC projects a break occurring once every 1,000 operating years; a complete guillotine-type break occurs once every 20,000 operating



Depicted above are two differing loss-of-coolant accident (LOCA) scenarios as put forward by the AEC and the critics. In the AEC scenario, the emergency core-cooling system (ECCS) works; in the critics' scenario, the ECCS fails.

years. To calculate the probability of a major pipe break in a nuclear coolant system, the AEC leaves out the extra safety factor of nuclear-grade pipe and simply uses the conventional figures, saying that a small break causing a minor release of radioactivity — one to 10 curies — will occur once every 1,000 reactor-years, and that a guillotine-type break that would call on the full resources of the ECCS will occur once every 20,000 reactor-years.

Critics question these estimates on two grounds. First, it is claimed that the AEC calculations do not take into consideration the fact that the new reactors are bigger than any built before, and that this scaling-up in size could produce some unexpected phenomena; and second, that neither reactor builders nor electric utilities are living up to the high standards of the quality assurance program of the AEC.

This was graphically illustrated in 1971 when technicians began pulling fuel rods out of the Beznau 1 reactor in Switzerland for a routine refuelling. They found that the fuel pellets in a number of the rods had slipped down several inches, and that many of the rods were deformed as a result by the great pressures inside the reactor (but with no escape of fuel).

Not long afterwards, technicians refuelling the Ginna reactor at Ontario, NY, found the same thing — fuel pellets had slipped within the rods, leaving gaps of several inches; dozens of rods were partially crushed, bent and cracked.

An investigation was started hastily, and AEC experts believe they have an explanation. Present day fuel rods for PWRs are pressurised with helium. Both plants used older fuel rods that did not have helium pumped in for pressurisation.

The fuel pellets inside those rods, by industry custom, are compressed to only 92 per cent of their maximum possible density. The extra space, in microscopic pores, is left to allow for the slight expansion that occurs during fission. But heat and radiation inside the core collapsed the pellets, and they slipped down; the unpressurised rods then collapsed.

The AEC now says the situation is well in hand. "The fix is obvious," says Edward E. Sinclair, assistant director of reactor technology. "We can't use unpressurised rods. It will be implemented in a couple of years."

Others aren't so assured. The reactors in which fuel-rod crushing occurred are only half the size of the reactors now coming on line, and many fear that more disquieting phenomena might be lurking in the bigger plants.

Exactly which problems are size-dependent is an unknown.

What is known is the unhappiness about the way the vendors and the utilities are building and running nuclear plants. "We don't seem to be able to get quality assurance," complains AEC's Ed Sinclair. "This is where we have to spend time, money, and exhortations to industry. We've got to improve the quality of workmanship and the quality of design that real people in real situations are able to produce." The utilities, he goes on, don't seem to have prepared for the extra complexities of running a nuclear plant.

The AEC regards such incidents as deplorable but perhaps inevitable at this stage of the game. "The industry is only 15 years old," says Ed Sinclair. "We're on a learning curve. It's obvious that these are learning experiences. The industry is so young that some executives don't understand what their responsibility is."

What this can mean in practice was illustrated by an incident at the 809-megawatt Dresden 2 plant, a BWR, in Illinois on June 5, 1970. It started with a minor malfunction that led to a chain of events — complex but not improable — that caused damage in the core but stopped short of a disaster. Key equipment did not function adequately, the reactor operator did the wrong thing, there was a glaring error of design in the positioning of a safety valve — but there was no release of radioactivity outside the plant. The reactor operator, Commonwealth Edison Company, was left with an expensive cleanup job and a need for major revision of operating procedures, but with nothing approaching a major disaster.

But there have been more specific incidents that brought the AEC into action. Take the incident of the misplaced steam lines, which started with an anonymous letter telling the AEC that the Northern States Power Company's incomplete Prairie Island plant in Minnesota had a steam line running through a building that contained safety equipment and also under the control room; a break in the line at those points could knock out equipment and operators. Following up the lead, the AEC found the same situation in several other reactors. Eventually, the AEC asked those utilities to prove that safety-equipment buildings were protected against such accidents.

And then there is the whole issue of valves. Every nuclear plant contains between 600 and 1000 valves, and the performance record is far from perfect. According to a 1972 AEC report, faulty valves caused approximately one coolant release incident (albeit minor ones) for each two reactor-years of operation.

Perhaps the most extensive test of AEC's quality-assurance program involves valves. It began in 1970, when an AEC inspector asked a utility for the documents attesting to the quality of several valves. The utility found it didn't have some documents, and that the documents that were available indicated that some valves were not up to specification thickness. Eventually, the AEC learned that the required documentation was missing for 10-20 per cent of all valves in nuclear plants. A follow-up program by the AEC resulted in most licensees correcting this situation.

However there are now several indications that the AEC is getting tougher.

Last May, the commission fined the Virginia Electric and Power Company $40,000 for alleged violations of safety regulations at the company's Surry nuclear plant — the first fine ever imposed on a utility for nuclear-plant safety infractions.

That same month, Dixy Lee Ray, the tough-minded marine biologist who is AEC's new chairman, staged what amounted to a coup d'etat when she forced through a vote taking reactor-safety research out of the hands of the Division of Reactor Development and Technology. That move met a long-standing complaint of critics, who pointed out that the division was charged both with promoting nuclear energy and with overseeing the safety program. Safety research now has its own AEC division, headed by Herbert C. Kouts, a man with long experience in reactor safety.

What is the chance of a major accident that would release large amounts of radioactivity? The AEC estimates that such an accident will happen once in 100,000 million reactor-years. A University of California study estimates the chances at one in 100 million reactor-years. The critics estimate the chances to be much higher — well within probability.

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The Royal Institution: home to Michael Faraday

In 1812 a young apprentice bookbinder visited the Royal Institution in London and was impressed by several lectures by Sir Humphrey Davy on chemistry. Michael Faraday promptly gave up his bookbinding to devote half a century to the practice of science. Faraday's laboratory at the Institution has now been restored and opened to the public.

by MARTIN SHERWOOD

The Royal Institution, home and workplace of some of the most noted men of science, from Davy and Faraday, through Tyndall and Dewar, to Sir Lawrence Bragg and the present director, Nobel laureate Sir George Porter, still stands in Albemarle Street, Mayfair. But during the years its famous occupants have worked there the Royal Institution's main laboratories and lecture rooms have undergone many changes. In fact only two parts of the building remain as they were originally: the main hall on the ground floor and the servants' hall in the basement. It was in the basement that Faraday executed many of his experiments on electricity and magnetism.

After two years of restoration and renovation this important scientific site has been opened to the public. Adjoining it are a new museum concerned with Faraday's life and work and the archives of the Royal Institution containing many letters and documents of the scientists who have worked there.

It was in March 1813 that Faraday gave up his trade and moved to two rooms at the Royal Institution where, for a salary of 25 shillings a week, he was employed as an assistant in the laboratory. Prior to attending Davy's lectures Faraday had developed an interest in science through lectures given by John Tatum at the City Philosophical Institute. Here he had made friends with a number of young men interested in natural philosophy and had become sufficiently engrossed by science to spend part of his income on materials for chemical experiments.

Thus, although his new job was not specifically intended to involve more than assistance at lectures and looking after apparatus, he was soon helping Davy with his chemical researches.

Until this time most of his knowledge of science was self taught, learned from books he had had to bind during his apprenticeship. But in the autumn of 1813 he was invited to accompany Davy on a tour of the scientific centres of mainland Europe. This grand tour, which lasted for 18 months, was for Faraday the equivalent of a university education; in Paris alone he met Ampere, Cuvier, Humboldt, Gay-Lussac and other notable scientists.

Shortly after his return to England Faraday was re-employed by the Royal Institution. Davy was now living away from the Institution and relied increasingly on Faraday to carry out his research. Davy's successor as Professor of Chemistry was less involved with the running of the Institution than Davy had been; consequently Faraday had to undertake an increasing amount of administration of the building and in 1821 he was given the title 'Superintendent of the House and Laboratory'.

The Royal Institution at this time was not just a place of scientific research. It had been founded in 1799 by Count Rumford as 'a Public Institution for diffusing and facilitating the general introduction of useful mechanical inventions and improvements, and for teaching, by courses of philosophical lectures and experiments, the application of science to the common purposes of life'.

In 1824 Faraday delivered his first lectures there, and in the following year when he was made Director of the Laboratory he arranged for the first of the weekly meetings of members which subsequently developed into the famous Friday evening discourses (still held today) at which eminent scientists describe their recent work.

The basement laboratory which Faraday directed and worked in adjoined the ser-

Above, left, a watercolour by Harriet Moore of Faraday's magnetic laboratory. Faraday's great electromagnet, used in many of his experiments, can just be seen on its supporting stool beneath the table. A close-up of the magnet (now on display) is shown above right. It was made from a section of ship's anchor chain.

vants' hall which had a cellar opening off it. Faraday used both: the servants' hall became his magnetic laboratory and the cellar became "the froggery", where he kept the frogs needed for some of his electrical experiments.

In addition to his work on electricity and magnetism, Faraday discovered a number of new organic chemical compounds, including benzene; studied improvements in steel alloys and optical glass; and liquefied a number of common gases for the first time.

He also undertook consultancy work on subjects ranging from analysis of oatmeal samples to gassing problems during the construction of Brunel's tunnel under the river Thames. He showed a wide ranging interest in different aspects of the relationship between science and society.

He wrote to The Times, for instance, on the alleged para-normal phenomenon of table-turning and on the pollution of the Thames. However, it is his work on electricity and magnetism carried out over a period of 40 years on which his fame most lastingly rests.

Following the observation made in 1820 by the Danish scientist, Oersted, that a magnetic needle is deflected by an electric current passing through a nearby wire, Faraday began to investigate the relationship between electricity and magnetism. In late 1821 he built an experimental apparatus with a fixed wire around which a magnet could rotate. When current passed through the wire the magnet did rotate: a reconstruction of this experiment, the first electric motor, operates in the new Faraday Museum.

Faraday's greatest achievement came, however, nearly 10 years later. In the autumn of 1831 he discovered electromagnetic induction. Over a period of nine weeks during which, according to his notes, he spent 12 days of concentrated research on the subject, Faraday produced both the first transformer and the first dynamo.

This was not the end of his contribution to the study of electricity and magnetism. In the Faraday Museum there are displays of the apparatus used in experiments on electromagnetism, electromagnetic induction, electrochemistry, dielectrics and discharge in gases.

This drawing of Michael Faraday, made by George Richmond, is on view at the new Faraday Museum, Royal Institution, in London.

In the original laboratory, now seen through a glass wall, is the great electromagnet used in many of his experiments. Built about 1845, this was constructed from a section of ship's anchor cable. Faraday himself did the windings — this at a time before the introduction of insulated wire so he had to wind not only the wire but the insulation of shellaced cotton too.

The museum also contains a number of Faraday's private possessions: for example, his travelling dressing-case and safety spectacles and the presentation sword given him in 1842 by General Anossoff in recognition of his work on steel alloys. Also on display are papers and documents, including the book of notes which he made of Davy's lectures in 1812 and, after binding it, presented to Davy by way of intruction.

There seems little doubt that, to those with an interest in science, the Faraday Museum and Laboratory will become a must on the it nerary of a visit to London.

At left, the "Electric Egg" used by Faraday for studying discharge phenomena in gases. Above, HM The Queen uses the original iron ring used by Faraday in 1831, when he discovered electromagnetism, to unveil a plaque to mark the opening of the Faraday Museum.

Are you a safety hazard? Test yourself with a

Reaction Timer

by LEO SIMPSON

Last month we presented the Buzz Bar to test your co-ordination. Now you can check your reaction time. When the red light comes on, go for the stop button or pedal as fast as you can. The time you take comes up on the meter. For the button you should be less than 250 milliseconds; for the pedal, less than 400 milliseconds.

When you are driving, your reaction time in an emergency can make the difference between rapid evasive action and possible fatalities. It is well known that reaction time is affected by the driver's physical condition and his psychological outlook at the time. In some cases, the driver does not register the emergency at all and drives straight into a disaster.

Some people stoutly maintain that alcohol does not adversely affect their reaction time and may even improve it. Limited tests that the author has witnessed would indeed seem to indicate that a limited amount of alcohol does not affect physical reaction time to any extent. What is affected is judgment. But that is another story.

Eventually, reaction time testing may become part of the general driver licensing procedure. Even licence renewals may be conditional upon passing a reaction test and sight test. Who knows? In the meantime, we have produced a unit to measure reaction times up to one second. If your reaction time is longer than that you are disaster material anyway!

The unit presented here will enable a number of interesting reaction tests to be made. To perform the tests, two people are required. One acts as a starter and presses a button to light up an indicator on the tester. The other person is the one being tested, and must hit their button to turn off the light. The reaction time can then be read from the meter. The starter then has a reset button to zero the meter before the test is repeated.

An approach to measuring a short time interval of less than one second can take two general directions. First, logic circuitry can be used and the result displayed in digital form. All that would be required is a 100Hz square wave oscillator driving a couple of decade counters, plus the necessary decoder / driver integrated circuits to drive the neon or light-emitting diode digital display. The test would be merely starting and stopping the clock. The readout would be in the form of two digits which would be multiplied by ten to give the result in milliseconds. For example, a readout of 34 would represent 340 milliseconds.

While this concept is quite simple and easily extended to provide greater measuring accuracy down to 1 millisecond or less if required by the addition of more counter stages, it has drawbacks. The first of these is the power required. Unless CMOS logic circuitry was used, the unit could require the best part of 200 milliamps at 5 volts. This means that it would require a fairly large battery or be mains operated. And by the time the cost of all components was added up, it would not be a cheap project.

To avoid these problems we decided to see if we could achieve the desired result by an analogue approach. The obvious solution was to produce a steadily rising voltage and measure its value at the end of the given time interval which represents the reaction time.

But how do you produce a steadily rising DC voltage, ie, a voltage increasing at a constant rate for a maximum interval of one second? Actually, that is easy. All that is required is to charge a capacitor at a constant current. The resulting voltage across the capacitor will rise at a constant rate.

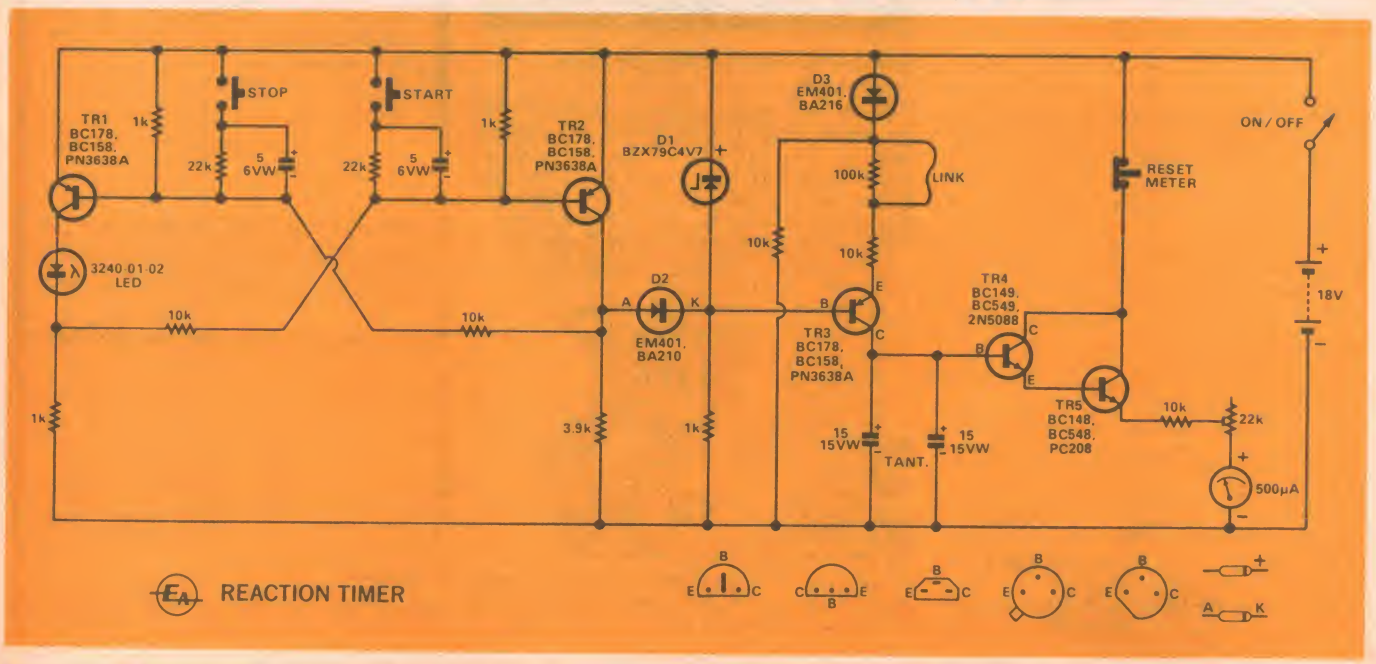
This can be shown by derivation from the fundamental relationship:

$$Q = CV$$

Where V represents voltage,
Q represents charge in coulombs
and C represents capacitance in Farads.

If we rewrite the above equation as $V = Q / C$ and then divide both sides by time in

An R-S flip-flop, a constant current source and a Darlington emitter-follower comprise the circuitry of the Reaction Timer.



seconds, we get the rate of voltage change in volts per second is equal to the number of coulombs per second divided by the capacitance. But 1 ampere is equal to 1 coulomb per second, ie, current is the rate of charge flow. So dividing the capacitor charging current by the capacitance gives us the rate of voltage change. So the way to get a constant rate of voltage increase is to charge the capacitor with a constant current.

We can set the rate of voltage increase by selecting the value of constant current and the size of the capacitor. The capacitor must have very low leakage current relative to the value of charging current. The capacitor we decided upon is a parallel combination of two 15uF 15VW tantalum electrolytics. Conventional aluminium electrolytics must not be used, because of their leakage. If we select a rate of voltage increase of 10 volts/second, the constant charging current is 0.3 milliamps.

Refer now to the circuit diagram (Fig 2). The constant charging current to the capacitor is provided by Tr3 and its associated components. The basic circuit of a constant current source using one transistor is shown in Fig 1. A reference voltage provided by a zener diode is applied to the base of the transistor and the emitter resistor is selected to set the collector current. The voltage across the emitter resistor becomes the reference voltage minus the base-emitter voltage of the transistor.

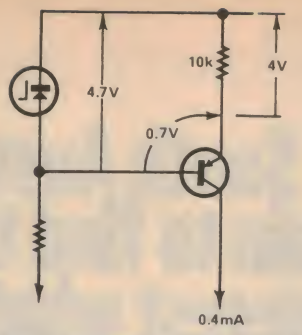
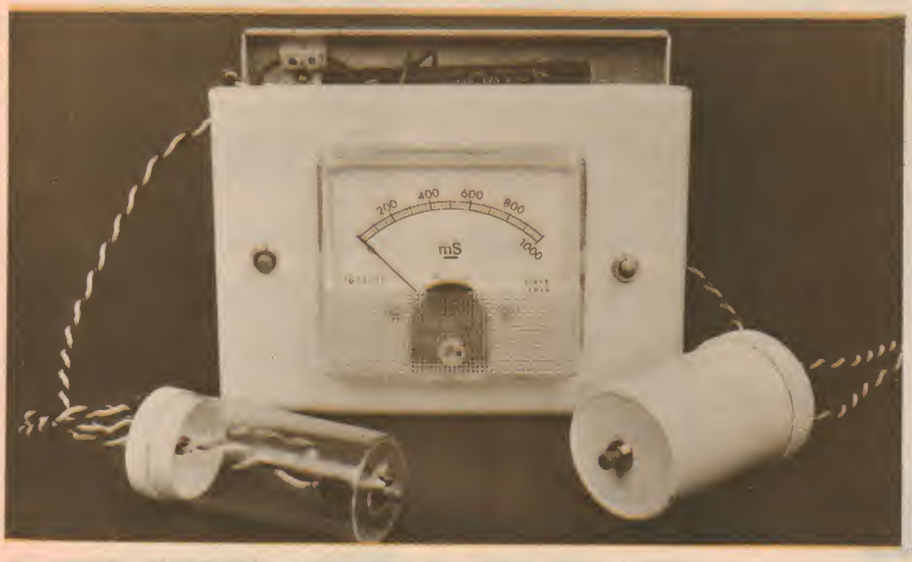


Fig 1. Basic constant current source.

a constant current source to charge a capacitor, we can now discuss how to start and stop the current source. We do this with an RS flip-flop consisting of Tr1 and Tr2.

The flip-flop has uneven collector loads. Tr1 has a 1k resistor in series with a light emitting diode while Tr2 has a 3.9k load. This means that when power is first applied to the circuit, Tr2 always turns on while Tr1 is held off. Tr2 effectively shorts out the voltage reference zener diode D1 via D2 which turns off current source Tr3. Just to make sure that Tr3 turns hard off, diode D3 is connected in series with the emitter. The diode voltage is held constant by bias current from resistor R1.



The STOP and START buttons for the reaction timer are mounted in plastic pill cases.

In the basic circuit we have shown a zener diode which provides a reference voltage of 4.7V. This would result in a voltage across the emitter resistor of 4.0V (allowing for a base-emitter voltage of 0.7V). The collector current is set at 0.4 milliamps by making the emitter resistor 10k. Any tendency for the collector current to increase would increase the emitter voltage by the same amount, which would bias the transistor off which would drop the current back to where it should be, and so on. The reverse process applies if the collector current tends to reduce.

Later on in the article we will explain the component differences between Fig 1 and the current source Tr3 in the complete circuit diagram.

Having described how to obtain a voltage which increases linearly with time by using

So the situation at switch-on is that Tr2 is on, which holds Tr3 off, and so the voltage across the 30uF composite capacitor remains at zero. To start charging the capacitor, the START button is pressed which momentarily removes the base voltage of Tr2. This turns Tr2 off and allows Tr3 to begin charging the capacitor at constant current.

At the same time as Tr2 goes off, Tr1 comes on and illuminates the light-emitting diode. The person being tested must then hurriedly press the STOP button which reverts the flip-flop to its original condition and turns Tr3 off. The voltage which then appears across the capacitor represents the elapsed time. All that remains is to measure this voltage while making sure that the capacitor's charge is not bled away so fast as to make the meter pointer drop rapidly. In other words, we have to measure the capacitor voltage but make sure that the current drawn off by the measuring circuit is as low as possible.

If you're not a South Australian reader, you're almost certain to find this announcement of no interest whatsoever.

Ron Robson.

Spiro Hanoumis.

Robin Davidson.

If you are from S.A. however, this is important.

On March 18th, Warburton Franki commenced operation as authorised Fairchild distributors in South Australia. They joined Gerard & Goodman in servicing that area.

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The Warburton Franki Fairchild team is Ron Robson, Manager Electronics; Spiro Hanoumis, Outside Sales; Robin Davidson, Inside Sales. Backing them up is Sales Supervisor Len Bannister, Jeff Mousley, Gary Francou, with Mike Rogers at Whyalla, and Ian Gard at Mt. Gambier.

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Our method of monitoring the capacitor voltage is to use a Darlington transistor pair to drive a 500 uA meter via appropriate resistors. With the high beta of the composite transistor the input current from the capacitor is very low — less than 1 microamp.

Other means could have been used to monitor the capacitor voltage, such as a FET source follower or operational amplifier "voltage follower," but these are not without drawbacks. Our circuit seems to have the advantages of economy and simplicity.

Several features of the circuit remain to be explained. First, the RESET button. This resets the meter to zero after a test so that it can be repeated. Notice that the capacitor is not discharged directly by shorting out. Rather, we remove the positive supply voltage from the Darlington, so that the capacitor discharges via the two base-emitter junctions and the meter circuit.

This effectively reduces the capacitor voltage to slightly less than the forward-bias base voltage of the Darlington pair, ie, slightly less than 1.2V. So instead of rising from zero at the start of a test, the capacitor voltage rises from approximately 1.2V. This means that as soon as the capacitor voltage begins to rise during a test, the meter pointer rises accordingly.

A simple, easy-to-reproduce calibration procedure presented a major problem in development of the project. No matter how ingenious or complex a circuit such as this might be, it is useless if it cannot be accurately calibrated by the would-be constructor who has a minimum of test instruments at his disposal. We believe we have solved this in a neat fashion.

The calibration is performed by altering the setting of the current source so that it delivers a smaller constant current. This is done by temporarily removing the wire link shorting the 100k resistor in the emitter circuit of Tr3. This increases the total resistance in the emitter of Tr3 to 110k and thus reduces the capacitor charging current to one-eleventh of the normal value. Now, the meter takes eleven seconds to reach full-scale deflection instead of one second.

So to calibrate the reaction timer, proceed as follows. Remove the wire link to insert the 100k resistor into circuit. Press the START button, wait a few seconds and press the STOP button. Now press the RESET button to zero the meter. Now press the START button, wait exactly eleven seconds and press the STOP button. Now set the 22k preset potentiometer so that the meter reads full scale. This will have to be repeated a few times because the meter reading drops slowly.

Having set the 22k preset potentiometer so that the meter takes exactly eleven seconds to rise from zero to full scale, the wire link can be replaced to short out the 100k resistor and the unit is ready to perform testing. Ideally, the 10k and 100k resistors should be 1pc units, but in practice 5pc units will be close enough.

We specify a LED in the circuit because it has almost instantaneous response time, ie, light is emitted as soon as voltage is applied. The use of an incandescent lamp in this role would inevitably cause errors because of the thermal lag of the filament.

PARTS LIST

1 chassis (see text)
1 meter movement, 500uA or 1mA sensitivity
1 Eveready 2512 battery plus connector
1 section of 0.1in Veroboard, 60 x 90mm approx
2 push-buttons with normally open contacts
1 push-button with normally closed contacts
1 SPST toggle switch

SEMICONDUCTORS

3 silicon PNP transistor, BC158, BC178, or 2N3638A
1 silicon NPN transistor, BC149, BC549, BC109, or 2N5088
1 silicon NPN transistor, BC148, BC548, BC208, or BC108.
1 zener diode, BZX79 / C4V7 (BZY88 / C4V7)
2 silicon diodes, BA216, EM401
1 light emitting diode, McMurdo 3240-01-02
or any other general purpose LED.

RESISTORS

(½W, 5pc tolerance)
1 x 100k, 2 x 22k, 5 x 10k, 1 x 3.9k
4 x 1k, 1 x 22k preset potentiometer

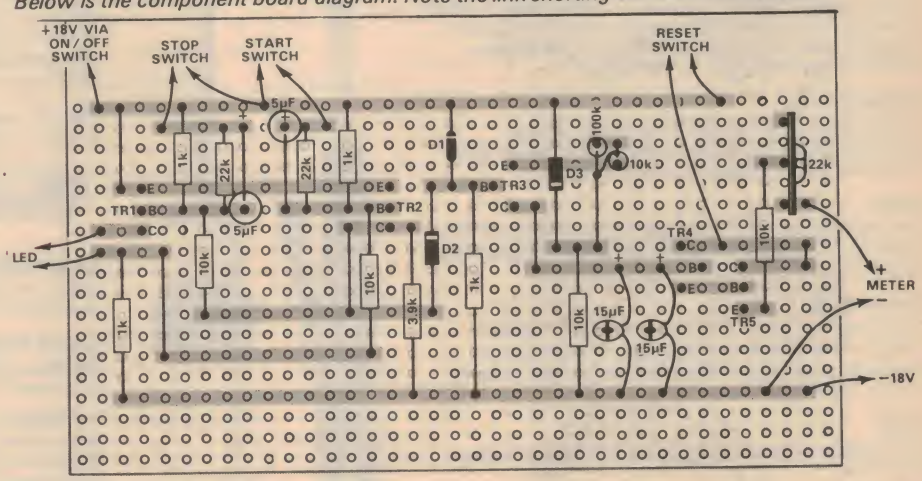
CAPACITORS

2 x 15uF / 15VW tantalum electrolytics
2 x 5uF / 6VW PC mounting electrolytics

MISCELLANEOUS

1 three-way insulated terminal block, hook-up wire, Letraset, bettery clamp, plastic pill cases, screws, nuts, lockwashers, solder.

Below is the component board diagram. Note the link shorting out the 100k resistor.



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All the circuit components are mounted on a small section of Veroboard approximately 60 x 90mm. We used Veroboard with 0.1in conductor spacing to accommodate Lockfit or TO-92 encapsulated transistors. We raised all the resistors off the board by about 8mm as it makes them easy to remove if that is necessary.

Inevitably, constructors will be presented with a diverse number of alternative transistors to the ones we have specified and while this should present no problems, they will all have different lead configurations. Check the transistors you are supplied with against the appropriate base diagram on the circuit.

Take care to observe correct polarity of the diodes and tantalum capacitors. This is shown on the wiring diagram.

The two resistors, 10k and 100k, associated with the constant current source, Tr3, are wired "end-on" and a loop of hookup wire soldered to their ends to short out the 100k resistor. The details are shown in the wiring diagram. The idea is to just "tack" the wire loop with your soldering iron so that it is easily removable for the calibration procedure.

We used a 500uA meter movement and made our own scale by erasing the existing scale with a typing eraser and lettering the new scale with Letraset. A 1 milliamp meter movement can also be pressed into service. The 22k preset potentiometer must then be changed to 10k and the associated 10 resistor reduced to 4.7k. No other changes are required and the calibration procedure is the same.

Notice that the 10k resistor in the base voltage divider for Tr2 is fed from the junction of the LED and the 1k resistor and not from the collector of Tr1. This is to avoid the small current flowing the 10k resistor from partially lighting the LED indicator.

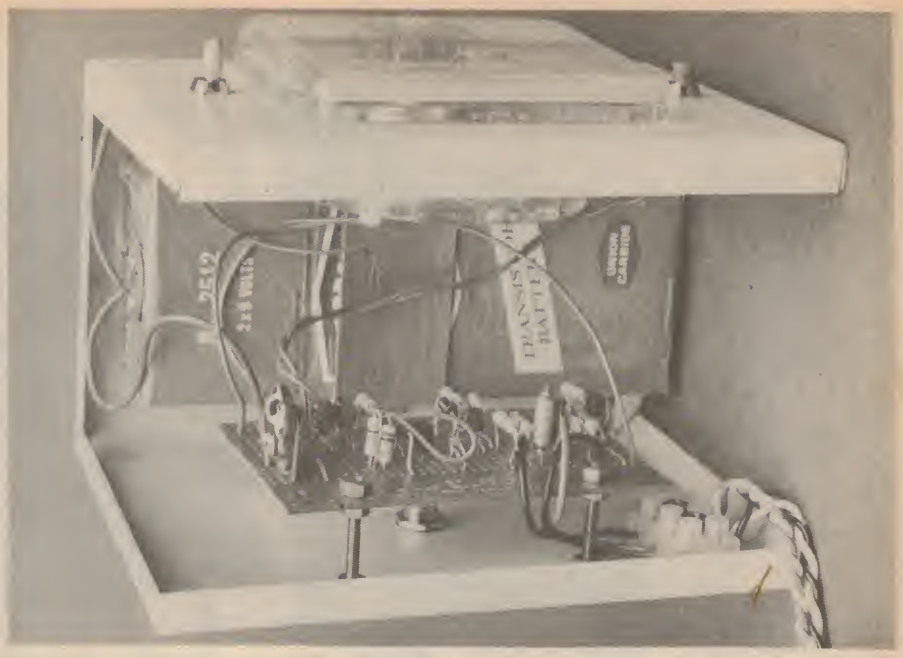
Total current drain of the circuit varies from 27 milliamps in the STOP condition to 34 milliamps in the START condition. With an 18V supply rail, a fairly large battery is required, such as the Eveready 2512.

Construction of the reaction tester is noncritical as far as layout is concerned. It can be built cheaply in a plywood box or dressed up to look the part of a fancy instrument. Our approach to the construction of the unit is shown in the photographs, but it is not at all mandatory.

The switches we used were all miniature types with normally closed and normally open contacts so they can be wired to perform any of the functions shown in the circuit. However, they are expensive and you will save money by buying the larger conventional switches. For the START and STOP switches you need pushbuttons with normally open contacts while the RESET switch has normally closed contacts.

The component board was stood off the rear panel of the tester with long screws and nuts while the battery was clamped to the bottom panel with a suitable clamp fashioned from a scrap of aluminium. The wires to the START and STOP switches were terminated on a strip of plastic terminal block to provide anchorage.

The LED stop light was mounted on the rear of our reaction timer so that the person being tested would not be distracted by the meter readings. But this is an optional arrangement and is inconvenient when the person being tested wants to see what time he has achieved. The LED we used was made by McMurdo and has an attractive chrome surround. Type number is 3240-01-02.



In this view of the timer, the LED indicator is partly obscured by the component board.

We mounted the START and STOP switches in plastic pill cases for easy use. The STOP switch could be mounted in a floor jig with a brake pedal plus accelerator pedal to simulate actual braking procedure, ie, lifting the foot from the accelerator and on to the brake pedal. Here the stop switch would have to be protected from mechanical abuse.

With this set-up you will be able to verify that the driver in a car with automatic transmission will have a shorter reaction timer if he brakes with his left foot. This is a handy advantage even though it is frowned upon by some authorities.

Approximate cost of the timer, if you use all new parts, will be of the order of $22 if you buy from one of the major kit suppliers. Go to it then. How fast is your reaction time?

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Details of April 1 changeover to Metric Time

Readers will no doubt be aware that from midnight on 1st April, 1974 the Australian commonwealth will convert to Metric Time. To assist readers in adapting to the changeover, we publish below details of the new units.

From midnight on April 1st, there will be 10 seconds to the minute, 10 minutes to the hour, 10 hours to the day, and so on. Units smaller than one second will be unchanged, as they already conform to the metric system: milliseconds, mocroseconds, etc. The new units for larger intervals of time are as shown in the following table:

IMPERIAL	METRIC
Second	Milliday
Minute	Centiday
Hour	Deciday (or Millimonth)
Day	Day
Week	Decaday
Month	Hectaday
Year	Kiloday
Millenium	Megaday

The fortnight has been withdrawn.

Obviously from the viewpoint of employers, due to the fact that one new hour represents only 5/12ths of an old one, employees might be expected to work longer, viz 3.33 decidays or millimonths per day. However as this is inconvenient for administrative and payroll purposes it is intended that the luncheon break will be shortened by 0.66 of a new hour, thus making a total daily working time of 1 new hour (1.00 decidays).

It is not expected at this time that any compensatory uplift will be made to salaries, except in the case of leap kilodays, where an adjustment will be built in at the end of the hectaday every 1.46 decamonths. Pension schemes will not be affected, but superkilo-daynation schemes will be adjusted to allow for the greater frequency of employee contributions.

It is not intended that either private individuals or companies will be eligible for compensation payments to assist with the conversion of clock faces, watches, timers or other equipment to suit the new units. However arrangements have been made for the Government printer in each state to produce stick-on Metric clock faces, in white paper. These will be made available through post offices, in 10 standard sizes, on the morning of April 1st.

Further bulletins dealing with specific aspects of the conversion to Metric Time will be published by the appropriate Authority as the need arises. In any case, the office of the Authority will be in a position to deal with telephone enquiries from 8 AM to 12AM on the morning of April 1st.

(With grateful acknowledgement to the News Bulletin, Hurstville Branch, Australian Postal Institute.)

Australia

'PABX' — manufactured by Plessey Telecommunications, this private automatic branch exchange system employs crossbar switching and componentry similar to that used by the Australian Post Office in the national telephone network.

Plessey Rodan indicator lamps designed for compatibility with and to enhance the presentation of electronic, electrical and industrial equipment. These indicator lamps are just some of the vast range available from Plessey Ducon.

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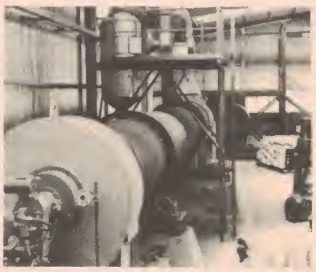
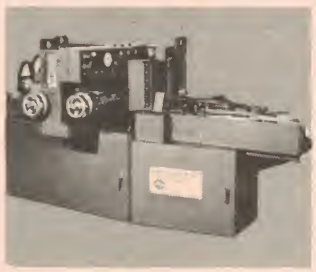


Plessey Rola is Australia's largest manufacturer of magnetic materials. Under agreement with B.H.P., Plessey have exclusive marketing rights for hematite and ferrite powders produced from Yampi Sound.



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Plessey Mallory interval timer switch — commonly used in automatic washing machines and electric ranges are supplied by Plessey Ducon located at Villawood, N.S.W.

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APP69/R1

Simple model train control

Here is a simple model train control for those enthusiasts who desire something more than the usual type of rheostat control. The controller gives better low speed performance and is fully overload protected, yet contains a minimum of components. Best of all, you don't need to be an electronic genius to construct it.

by DAVID EDWARDS

The conventional method of controlling a model train is by means of a rheostat (or variable resistor) in series with the supply voltage. This provides continuous control of the armature current and hence of motor torque.

While a very simple method, it has one notable disadvantage: the amount of series resistance in the supply circuit tends to give it a "constant current" characteristic, largely defeating the beneficial effect of back EMF within the motor. In other circumstances, when a motor slows down, back EMF falls and armature current rises, increasing the torque; conversely, when a motor speeds up, back EMF rises and armature current falls, reducing torque.

When the supply has a "constant current" characteristic, the ability of the motor to vary its torque is limited and a model loco, for example, becomes very sensitive to load variations. Low speed behaviour is particularly poor: the loco tends to slow down markedly on slight hills, and may in some cases stall.

Low speed behaviour of a model train can be improved considerably by using a variable supply having a low impedance characteristic. At any given setting, it will appear to the loco as a "constant voltage" rather than a "constant current" source.

Fortunately, the problem of providing a variable, low impedance supply for a model train can be greatly simplified by the application of electronic techniques. For example, a transistor connected in emitter follower mode, as in Fig 1, can impart a low impedance characteristic to an otherwise normal variable supply.

In itself, Fig 1 is not a practical circuit. A power transistor with a current gain of about 20, supplying up to 1.5 amps to the train, would require a base current rising to 75 milliamps. To minimise regulation problems in the potentiometer supplying the base, it would be necessary to arrange a current through it of the order of 1 amp. This would require a very high wattage potentiometer, and would be inefficient in terms of power consumption. The life of the power transistor could be of short duration, since the effect of a short circuit would be

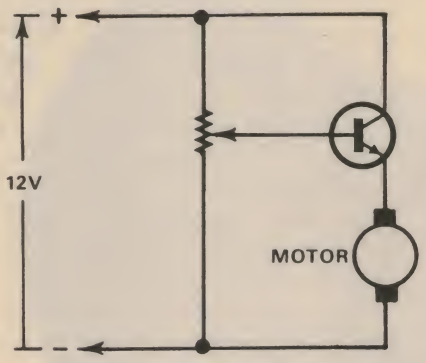

FIG. 1

catastrophic — and short circuits do occur in practical systems.

The first of these problems can be overcome by the use of a Darlington pair. Fig 2 shows the circuit involved. Using a general purpose transistor in combination with a power transistor in a compound configuration, we can achieve a gain of 800 or so. The base current required can then be approximately 2 milliamps — a much more practical figure. With a 12 volt supply rail, a 1k potentiometer is practical.

Protection against short circuits is provided by a filament lamp placed in the collector circuit and by a series base

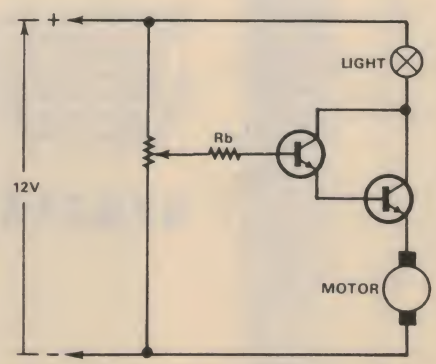

FIG. 2

resistor.

The lamp functions as a non-linear resistance and, under normal running conditions, the current through it is only a small fraction of its rated full load current. The filament remains cold and the resistance low, so that only a small amount of power is diverted from the train.

When a short circuit occurs, the current increases, the filament becomes hot and it's resistance increases approximately by a factor of eight. This limits the increase in current, and hence the power dissipated in the transistor. Visible indication of the overload can be obtained by placing the light beneath a red bezel.

The purpose of the base resistor is to prevent the composite transistor from turning fully on or saturating before the speed control potentiometer reaches the full speed position. It also helps to limit the current during overload conditions. It's value is determined principally by the full load current of the lamp. With a 50 watt lamp, a 2.7k resistor is suitable, while for a 25 watt lamp, a 5.6k resistor is suitable.

The final circuit, with values, is shown in Fig 3.

The choice of lamp depends upon the power consumption of the train motor and any auxiliary equipment being supplied, such as carriage lights. For a single train only, it is possible to use a 25 to 30 watt 12V lamp, obtainable from most automotive spare parts dealers. A 27 watt lamp can be made by wiring the two filaments of a 21 / 6 watt stop / tail light in parallel.

If it is desired to "double head" trains, or to run auxiliary equipment, it will be necessary to use at least a 50 watt lamp, which can be obtained by using two stop / tail lights in parallel, or by using one filament of a headlight bulb. The former method is cheaper, but the latter may be more convenient. Those readers with older style cars may be able to use an old bulb which has one filament broken. For an exceptionally large or heavy load, it may be necessary to use both filaments of a headlight bulb in parallel.

No damage will be caused to the headlight bulb by using both filaments in parallel

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GENERAL ELECTRIC

because it will only be energised fully for brief periods during overload conditions.

The controller requires a supply of 12V DC, rated at about 1.5A. This should be adequate provided that it is not overloaded for prolonged periods. It is not necessary for the supply to be smoothed; in fact a little AC ripple is helpful in overcoming the "stiction" inherent in most models. The normal commercial "train transformer / rectifier" is quite suitable as a supply.

Since the component and wiring layout is not critical, construction of the unit should cause no difficulties, even for inexperienced readers. A 5" x 2¼" aluminium box was used for a case, doubling as a heatsink for the power transistor.

The input and output terminals were mounted on one end of the box, and the power transistor on the other end. This transistor must be insulated from the metalwork, using a mica washer and plastic bushes. Note that silicon grease should be used to thermally bond the case of the transistor to the box.

The mounting lug of a terminal strip was fixed to one of the mounting bolts of the transistor to provide the collector connection, the TT801 and the base resistor being then attached to the strip.

The overload bezel, reversing switch and speed control were mounted on the top of the box, and rubber feet on the bottom.

The lamp was a dual unit made from two 21 / 6 watt car stop / tail lights. They were soldered together using tinned 18 gauge copper wire, which was then used to support them in position underneath the bezel, as shown in the photograph.

When the construction is completed, the unit can be tested. Connect a suitable power supply to the input terminals, making sure that the polarity is correct. Connect the output terminals to the tracks, and place a train on them. When the speed control is advanced, the train should run smoothly and it should be possible to vary its speed over a wide range.

While the train is at maximum speed, a screwdriver or some other suitable tool can be used to short the rails. The train should stop and the overload bezel should glow.

PARTS LIST

1 2N3055 power transistor with insulated mounting kit
1 TT801 transistor
1 2.7k ¼ watt resistor
1 1k lin pot
1 DPDT toggle switch
1 red bezel
4 terminals
1 3-lug tag strip
1 lightbulb (see text)
1 AMB 9 Minibox (127 x 57 x 57 mm).
4 rubber feet
1 knob
Hookup wire, solder, screws, nuts, 18 gauge tinned copper wire

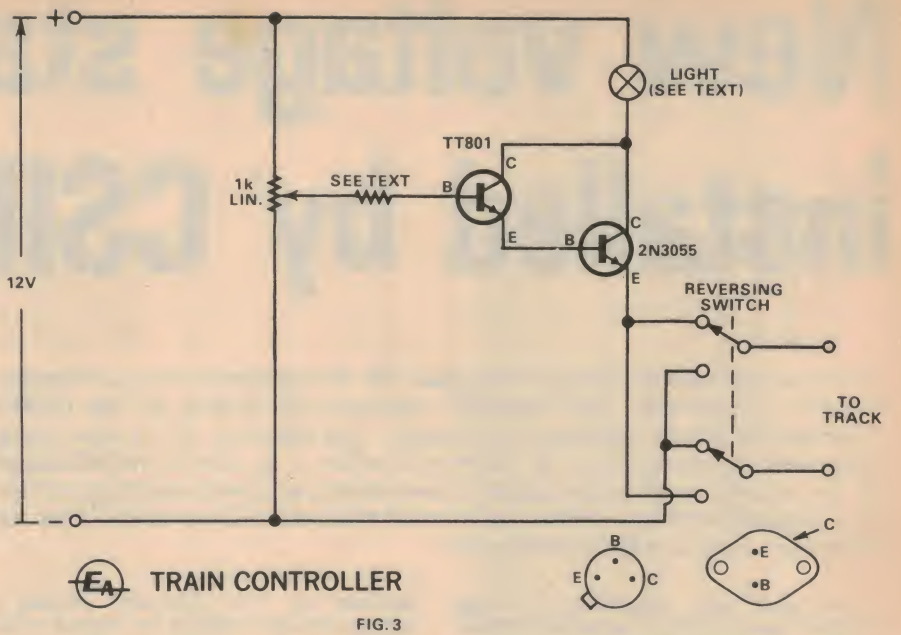
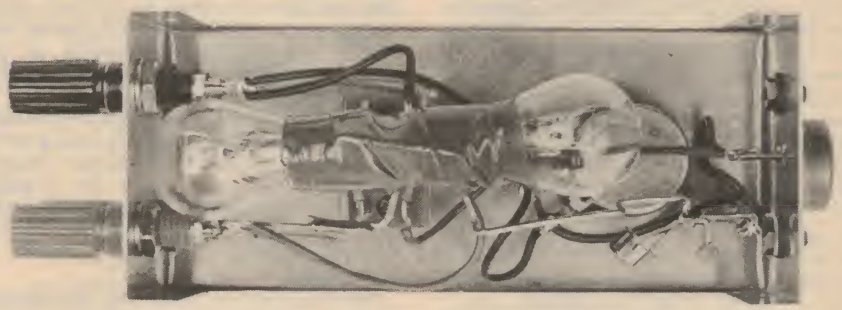


FIG. 3

The complete schematic circuit for the controller is shown above, whilst below is an interior view of the completed unit. Best results will be obtained if the rails are kept clean by regularly wiping them with methylated spirits.



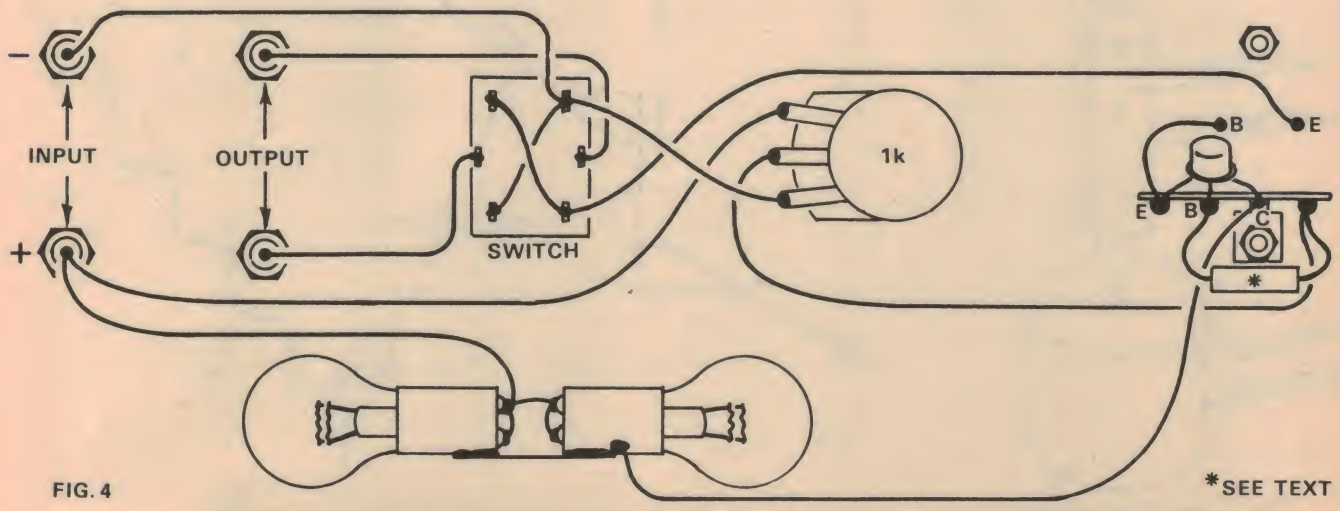


FIG. 4

*SEE TEXT

The very simple wiring layout of the controller is shown above. Note that one of the lightbulbs is positioned underneath the bezel.

New voltage standard installed by CSIRO

A precise standard of voltage is necessary for the calibration of much modern electronic equipment. The Australian standard volt is kept by the CSIRO National Standards Laboratory in Sydney. The standard volt is now being maintained more precisely —to 1 part in 10 million —by using a method based on the peculiar quantum behaviour of electrons in a superconducting junction (the Josephson effect). Andrew Bell visited the Laboratory and saw how the Josephson effect is being employed.

Until last year, Australia's voltage standard was a bank of saturated Weston standard cells kept under extremely delicate care at the CSIRO National Standards Laboratory in Sydney.

Why were the cells superseded? With Weston cells there were three problems. Firstly, each cell was liable to unpredictably drift in voltage. This is why a bank of cells was used, the idea being that cells that drifted excessively could be identified and replaced. Secondly, the cells were also very sensitive to loading, so that great care was necessary to minimise loading of a cell while measuring its voltage, otherwise a permanent voltage change could be caused. The other effect was that the cells were extremely sensitive to temperature change, so much so that they were kept immersed in a temperature-controlled oil bath held constant at 20C to within .001 degree.

Despite the oil bath, temperature fluctuations restricted the precision attainable in voltage measurements by the Laboratory. The cells changed their voltage by 40 ppm for every degree C change in temperature, and they were even more sensitive to temperature gradients: a difference in temperature of one degree between the two electrodes created a voltage change of 330ppm. So, control to .001 degree C, with particular attention to temperature uniformity, is required to achieve a short term stability of parts in 10 million.

If there were a voltage which did not fluctuate then we would have a very much more precise voltage standard, limited only by the sensitivity and stability of our measuring equipment (comparison circuits, galvanometers, and so on).

In recent years, a voltage source has been discovered which is absolutely stable as far as we can tell: the "Josephson voltage." For the moment, let's say it's a stable voltage that occurs in a Josephson superconducting junction when it is irradiated by electromagnetic radiation, such as microwaves.

For the past two years, Mr Ian Harvey and his colleagues at NSL have been monitoring the fluctuations of the standard cells by comparison with the Josephson voltage. NSL was one of only a few standards laboratories around the world to carry out this comparison and demonstrate the superiority of the Josephson voltage for stability.

The laboratories intercompared their standard cells by transporting them from one laboratory to another in temperature — controlled enclosures. The intercomparison showed that the monitoring by each laboratory using the Josephson effect, although done by using different techniques, agreed to within 0.1 parts per million. The Josephson voltage has now superseded the standard cells as a voltage standard.

Experiments have shown that the Josephson voltage is independent of all environmental effects — temperature; size, shape and material of junction; magnetic fields; power of incident radiation — and depends only upon the frequency of the incident radiation. Since this is the case, the important thing to notice is that we can now specify a particular voltage by simply specifying that particular frequency which produced it! And as it happens, frequency is the most accurately measurable physical quantity: parts in 100,000 million can be measured using a caesium-beam atomic clock. Compare this with the accuracy of standard cells — only parts in one million.

What is the "Josephson voltage?"

The Josephson effect, more specifically the AC Josephson effect, is named after B. D. Josephson who predicted it in 1962. It was soon confirmed experimentally. The effect is a peculiar quantum phenomenon that gives constant and precise voltage steps in the current-voltage characteristics of a superconducting junction, when it is irradiated by electromagnetic waves. A diagram of such a junction is shown in Fig 1,

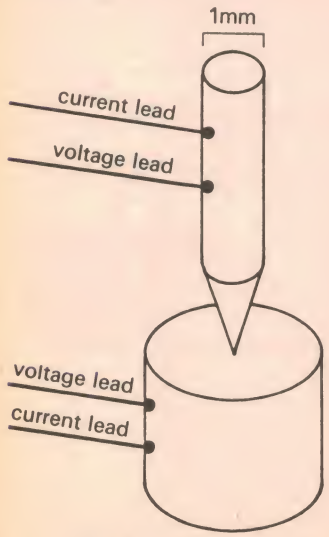


Fig. 1 Josephson junction
Niobium point contact type.

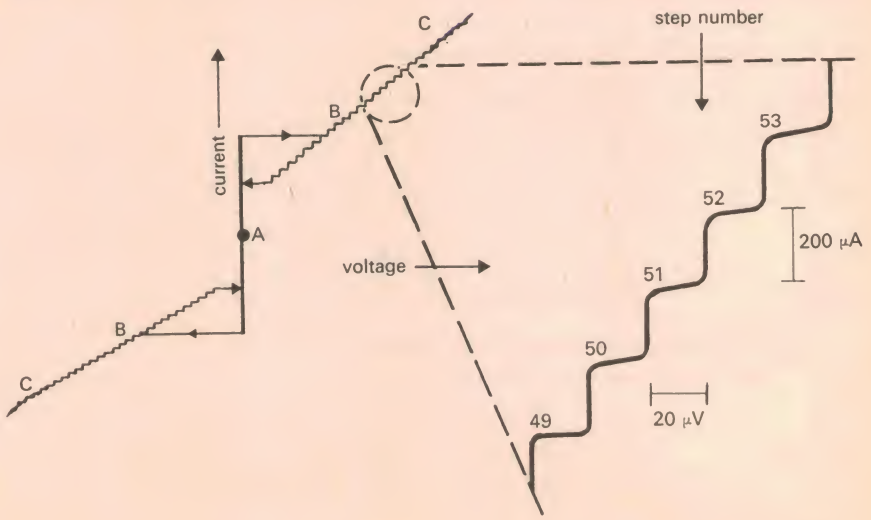
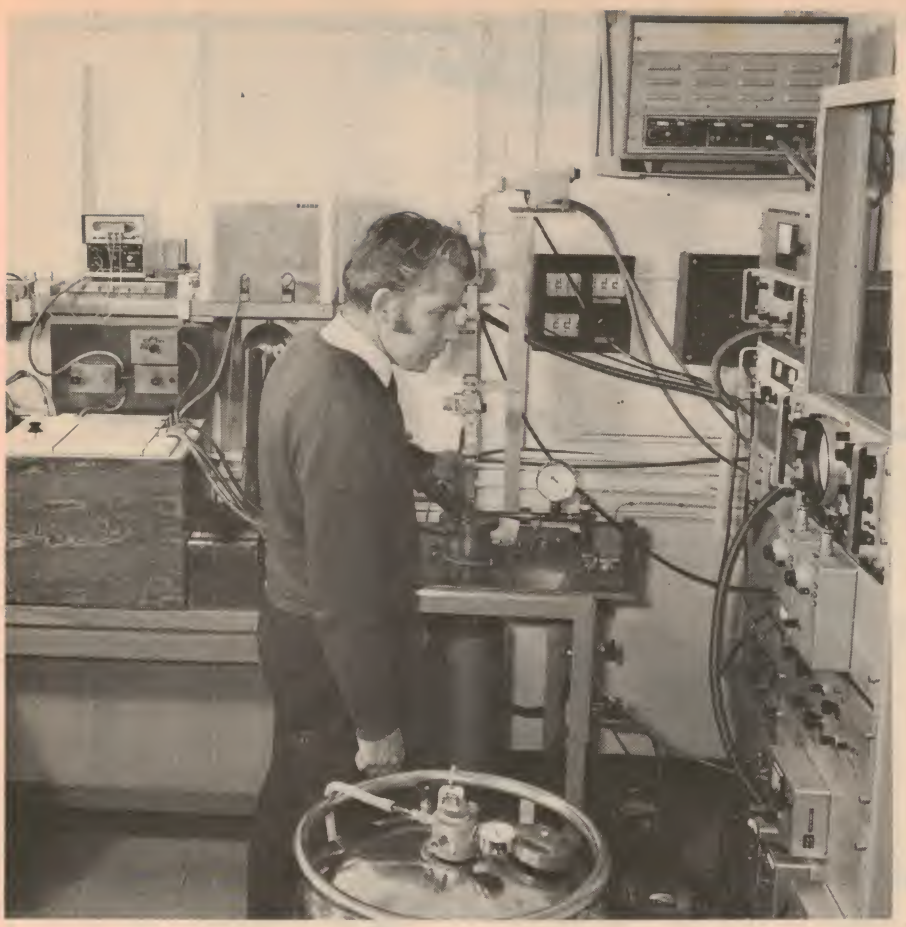


Fig. 2 Current-voltage characteristic of a point contact Josephson junction.



Depicted above is the apparatus at the CSIRO National Standards Laboratory for maintaining the Australian standard of voltage using the Josephson effect.

and Fig 2 shows its characteristics. The "Josephson voltage" is a convenient term for referring to the voltage of such a step. It is this voltage which is compared with the standard cells, and which has now come to supersede them in providing a standard volt.

If you didn't catch all of that last paragraph, let's take it more slowly.

First the junctions. The ones used at NSL are "point-contact" junctions, as shown in Fig 1. They are formed by pressing a sharpened (about 2um radius) niobium wire against a flat niobium anvil. In use, the junction is immersed in liquid helium at a temperature of 4K (-269C). At this extremely low temperature niobium is a superconductor — that is, it normally offers no resistance to the conduction of current. However, the point-contact junction does have a current-voltage characteristic (as shown in Fig 2) due to effects that were first predicted by Josephson, and which are now named after him.

In the vertical part of the characteristic (A), a current flows through the junction without producing a potential difference — this is the DC Josephson effect and it displays the expected superconductivity behaviour.

But when the current is increased further, a finite voltage V appears across the junction and an alternating super-current flows through it. This is the AC Josephson effect. The frequency f of the alternating supercurrent is simply given by

Eqn (1) . . . $f = (2e / h)V$

where e is the charge on the electron and h is Planck's constant. The factor 2 appears due to the pairing of electrons (forming what are known as Cooper pairs) in a superconductor. 2e / h has the approximate value of 484 Terahertz per volt.

In the presence of microwave radiation, a locking phenomenon occurs in which the frequency of the alternating supercurrent locks to the fundamental or a harmonic of the impressed microwave frequency. This locking is evidenced by the production of constant voltage steps as shown in region (B) of the characteristic. These steps mark definite points on the characteristic, and give us a precise, stable voltage ("Josephson voltage") which we can measure, or better, use as our standard volt. The slope of these steps seems absolutely vertical to within present experimental errors of parts in 1,000 million.

Remember that the size of each identical step is independent of junction materials, geometry and environment. In one experiment at NSL, two Josephson junctions were connected back to back. The potential difference across them was measured as less than 2 pico volts! The only thing that the voltage of a step depends upon is the frequency of the incident microwaves. The relationship between the microwave frequency, fm, and the voltage of a step, v, can be shown to be simply:

Eqn (2) . . . $v = n(h / 2e)fm$

where n is the number of the step.

How does NSL measure the Josephson voltage? By selection of step number and

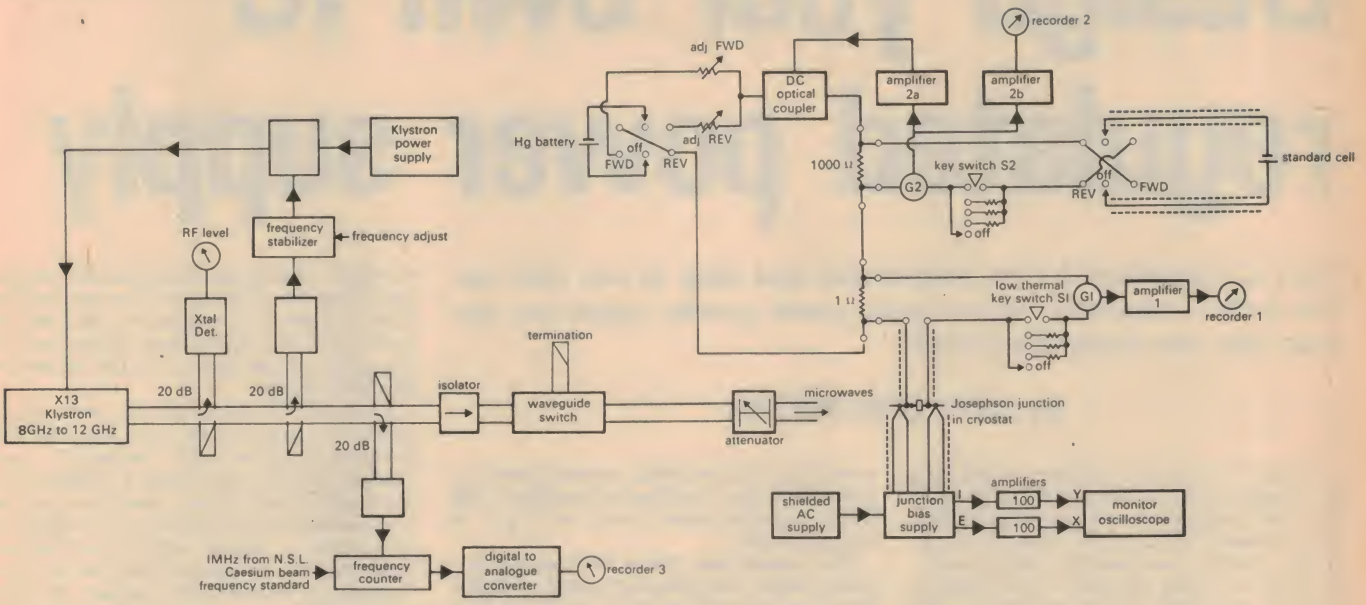


Fig. 3 Block diagram of apparatus for comparison of Josephson voltage with a standard cell.

microwave frequency, the voltage of the junction may be continuously varied, but limited to a maximum at the moment of a few millivolts. Noise and interference round out the steps at higher levels of the characteristic (C). The problem is now one of comparing a reference standard cell of about 1.086 volts at 20C with 1 or 2 millivolts at -269C.

A block diagram of the measuring apparatus as used at NSL is shown in Fig 3.

The voltages are compared using a fixed-ratio divider with a ratio of 1000:1 (marked 1000 ohms and 1 ohm on the diagram) accurately calibrated to parts in 100 million.

Firstly the voltage of the reference standard cell is balanced with the voltage across the 1000 ohm resistor created by current supplied from a mercury cell. Any imbalance is minimised by a servo-control system consisting of galvanometer G2, amplifier 2a and a DC optical coupler. The error of this servo system is continuously recorded, and by periodic manual adjustment, kept below .04 ppm. The optical coupler adjusts the current flowing through the 1000 ohm resistor to restore balance. The optical coupler is a combination of light-emitting diode and photo-detector, and permits DC coupling between circuits while maintaining extremely high insulation resistance.

One-thousandth of the voltage across the standard cell will now appear across the 1 ohm resistor (about 1 millivolt). The voltage from the Josephson junction, by virtue of equation (2), is brought equal to this potential by selecting the step number and adjusting the frequency of the microwaves. Typically, about the 50th step is used at a frequency near 9HGz. Balance is detected by galvanometer G1, whose output is also recorded. Thus, the experiment determines what Josephson frequency balances the standard cell.

People sometimes express surprise that galvanometers have been used as the null-detectors for these measurements, feeling that in a time of sophisticated electronics there should be a more sensitive detector. However, a galvanometer is a very sensitive detector, its sensitivity approaching that set by thermal agitation noise — and no electronic device can do better than that. The limiting noise sensitivity for galvanometer G1 is about 24pV for unity signal-to-noise ratio.

Careful screening eliminates RF and magnetic interference. The most troublesome disturbance is the thermal EMFs created by temperature differences in the leads between the liquid helium section and the room-temperature section of the apparatus. So long as the thermal EMF's are constant, they can be cancelled by reversal of polarities in the divider, standard cell, and Josephson junction. Unfortunately, they fluctuate slightly. In fact, they are the limiting factor in the precision of the experiment. Mr Harvey is now developing equipment that exploits new techniques only realisable at low temperatures and which will allow the complete comparison network to be operated at liquid helium temperatures.

The frequency record is the important result of the experiment — frequency is the measure of voltage. Computer analysis of the records of the outputs of galvanometers G1 and G2 allows a more precise measure of the balancing frequency to be calculated.

So: we now have our precise, stable Josephson voltage; we have compared it with the standard cell; and we know what frequency caused it. The standards labs say that they are "maintaining" the volt using the Josephson effect. That is, they have a volt "on the shelf" which you can "pick up" and compare with other voltages (such as the standard cell), just as you would a standard mass. Fine. But how do we put numbers on this Josephson voltage? How many volts is it? We can't use our standard cell which gives us "The volt" because it fluctuates and is less precise than our Josephson voltage — that was our original reason for trying to replace it.

Equation (2) provides a solution. We know that the Josephson voltage only depends upon frequency, so what we do is use equation (2) to specify voltage in terms of the frequency that caused it (which we do know very precisely — to parts in 100,000 million). The Josephson voltage becomes our standard volt and the standard cell is now used mainly as a working or transfer standard.

The conversion factor from volts to frequency is simply our constant $2e/h$. Although this can be measured by other experiments, the accuracy possible isn't nearly good enough for establishing a voltage standard, so we stipulate it to be exactly a certain number.

The conversion factor has been agreed upon by the Consultative Committee on Electricity which is associated with the International Committee of Weights and Measures. One volt now represents a Josephson frequency of 483.5940 Terahertz (exactly). On January 1 last year this new means of keeping the volt became legally established in Australia. The volt will now be more precisely known and will no longer drift with time. All the national volts in countries using this method will now be the same.

The conversion factor is consistent with the measure of the volt as given by the standard cell (so that your torch cell will still read 1.5 volts) but allows almost unlimited refinement in the precision of the volt. The main limitation at the moment is thermal EMFs. The present uncertainty is 1 part in 10 million.

The requirement of consistency among all our units means that the conversion value must also give us the right answer for the constant $h/2e$ that appears in equation (2). If this ratio becomes much better known through other experiments, we may then have to juggle the conversion factor slightly to remain consistent. Nevertheless, the size of our voltage step is of course, still the same (it's on the shelf to examine) and looks like being the standard of voltage for as long as we can foresee.

Design your own IC regulated power supply

New IC regulators are so inexpensive and easy to use that you can build a regulated, short-circuit proof power supply for less than the old unregulated kind.

by DON LANCASTER

Integrated-circuit voltage regulators have been around for quite a while, but they have been expensive and have needed lots of "outboard" parts to get them to work. Today, there's a new breed of voltage regulators here. These are low in cost ($2-5 in singles), very easy to use, and take very few outside additional parts. Some directly handle up to ¾ of an amp; others easily handle an amp or more with external pass transistors. Some are fixed-value outputs; others are variable. Some are dual pairs that give you two output voltages (one positive, one negative) out of the same package.

Why bother to regulate a power supply? For openers, the hum essentially disappears. Besides a rock-stable output voltage that is independent of temperature, line, or load variations, most designs are also short-circuit proof, shutting down or current limiting automatically. This protects the regulator and the supply against damage from shorts, and the current limiting will usually (but not always!) also protect the load from damage caused by wrong biasing or polarity mixups. Finally, a regulated power supply may actually be cheaper than an unregulated one, particularly if you need very low hum on the supply lines. This happens because you can usually use a much smaller filter capacitor.

For instance, if you wanted a 5-volt, 200-mA supply with less than 20 millivolts of ripple, single capacitor "brute-force" might take around a 80,000uF capacitor. With a regulator, you might design a power supply with a 16-volt output and four volts of peak to peak ripple, and do the job with a 400uF capacitor, with the regulator absorbing the "lumps" and giving a smooth output. Often times, the difference in capacitor cost is greater than the price of the regulator, particularly if the capacitor makes the case bigger, and regulated supplies can be cheaper than unregulated ones.

Of course, the problem with any power supply design is figuring out what size and voltage transformer you need, where to get it, what size capacitor to use, and how much fusing to provide. After that, we can tack a regulator onto the output.

Let's assume you're interested in output voltages that are low compared to the 240-volt power line, and are interested in currents between 50mA and an ampere or two. Let's also assume you are working with a 50-hertz, single-phase power line, as usual. For this particular type of power requirement, the transformer-coupled, full-wave capacitor-input circuit of Fig 1 is recommended.

The transformer drops the voltage to a chosen value and provides safety isolation. When its anode is positive diode D1 conducts and charges capacitor C. On the next half-cycle, diode D2 conducts and charges capacitor C. If there isn't too much load on the capacitor, it doesn't discharge very much between cycles and so the conduction time of each diode turns out to be very short. Very high currents flow very briefly during the diode conduction time and the current to the capacitor is delivered in narrow spikes. The amount of the current and the time width of the spikes depend on the load, the capacitor, and the internal resistance of the transformer, but the time spacing between the spikes is precisely half of a 50Hz power line cycle, or a time period of 10 milliseconds.

Fig 1 also shows the waveform at the capacitor and the load. It is essentially a fixed DC value from which a sawtooth waveform is subtracted. The frequency of the sawtooth is 100 hertz (for a full-wave rectifier), and ita depth depends on how fast the capacitor discharges. The greater the load for a given size capacitor, the more the capacitor can discharge between the charging current spiles and the higher the sawtooth ripple.

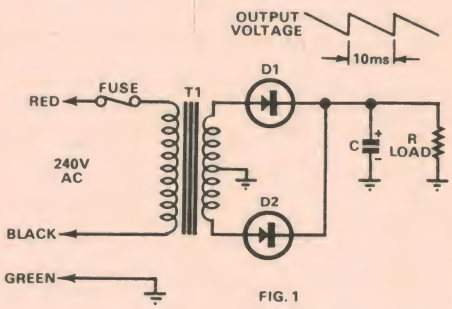


FIG. 1

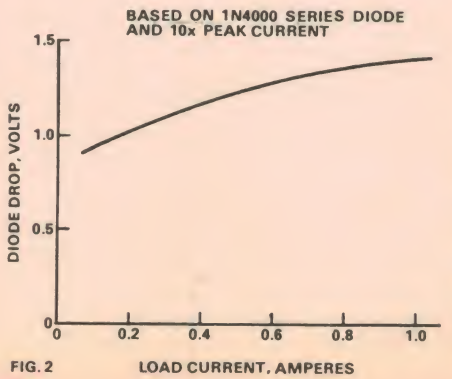


FIG. 2

There are two other possible circuits, the half-wave single diode one, and the full-wave one using a single (untapped) transformer winding and a bridge rectifier. The half-wave circuit takes twice the capacitor size and has twice the peak diode current. It also takes a bigger transformer as unbalanced currents and a resultant DC flow through the transformer windings. The full-wave circuit takes four diodes instead of just two and presents an additional diode drop between load and transformer. Besides this, you can only get one voltage from any given winding, while the Fig 1 circuit can easily get you several voltages since the transformer centre tap is grounded. Thus, unless you have a good reason not to, stick with the centre-tapped, two-diodes, full-wave, capacitor-input circuit of Fig 1.

There is no obvious "one-to-one" relationship between the transformer voltage and the DC output voltage. You do not get 6.3 volts of DC output from a 6.3-volt centre-tapped-transformer, or 12.6 volts from a 12.6 one and so on. While the game isn't quite this simple, it is easy to calculate the voltages you need for a given output.

Let's try the calculation "frontwards" first. Suppose you had a 6.3-volt RMS centre-tapped transformer, and to keep things simple, suppose further that the regulation of the transformer itself is very good, which is another way of saying the transformer can handle the load we want it to.

Each half of the 6.3 volt winding will be providing half of 6.3 volts or 3.15 volts. This is the RMS AC value. We need to find the peak value, for this is what charges the capacitor through the diode. The peak value

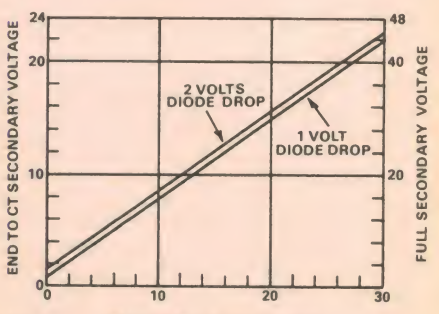


FIG. 3

BASIC FULL-WAVE RECTIFIER is shown at upper left. Diode voltage drop is plotted against load current at left, capacitor voltage against transformer volts in curve above.

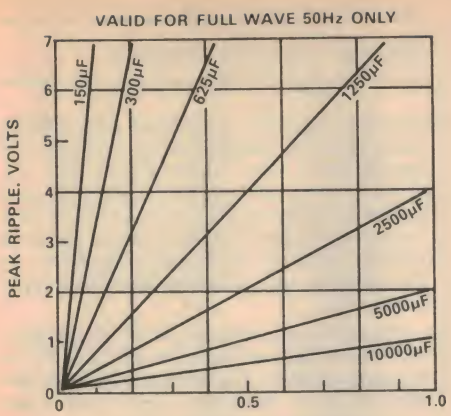


FIG. 4

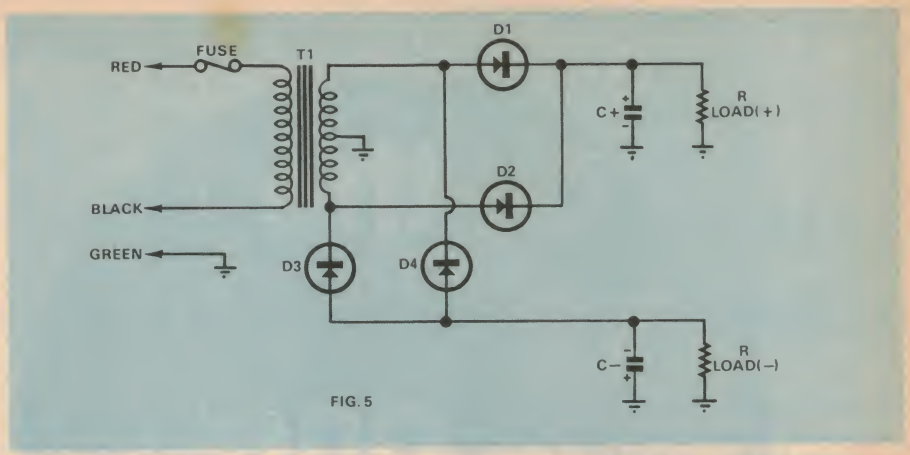


FIG. 5

RIPPLE VOLTAGE can be found quickly using the curve at left. The circuit at right shows how a negative polarity rectifier may be added.

is 1.41 times the RMS value or 3.15 x 1.41 = 4.45 volts.

If the diodes were perfect, we'd get a capacitor voltage of 4.45 volts. But the diodes have a conduction drop, and quite a bit more than you might expect, since, when they are conducting, they carry ten to twenty times the average load current. Remember that the diodes only conduct briefly. If they are only on for 1/10 the time, they have to conduct ten times the current the load needs.

The accurate way to find the voltage drop is to use a data sheet for the particular diode you are using and calculating the actual conduction angle, which is a pain. Figure 2 gives you a curve that is exactly valid for a 1N4000 series diode and a conduction time of 1/10 a complete cycle. This is close enough so long as you are using any reasonable silicon power diode. From Fig 2, we see that the drop will be around a volt for lower currents; let's use this figure. The diode drop subtracts from the available voltage, so the voltage across the capacitor is 3.45 volts. This is a peak value, from which we subtract the ripple voltage.

Fig 3 is a chart that relates the transformer voltage to the filter capacitor voltage for several values of diode drop. Use the chart directly or else use the following rules:

To find the peak output voltage:

1. Start with the transformer secondary RMS voltage
2. Divide by two to get the centre-tapped voltage
3. Multiply this by 1.4 to get the peak value
4. Subtract the diode drop, estimated from Fig 2, or subtract 1 volt for lower current operation.

To find the transformer voltage:

1. Start with the peak capacitor voltage.
2. Add the diode drop
3. Multiply by 0.707 to get the RMS value
4. Double this for the centre-tapped RMS value.

It turns out that you always design for much more output voltage than you really need if you are using a regulator. The regulator has a minimum dropout voltage above the output, which it needs for proper operation. The maximum voltage is limited by regulator breakdown or power dissipation. We'll see more on this in just a bit, but first. . . .

The size of the filter capacitor and the maximum load current determine the amount of sawtooth ripple you get. The accurate analysis of this is also a pain. We can make a very good approximation if we assume our ripple sawtooth voltage recharges very fast and decreases linearly. This both simplifies the maths and puts us on a conservative side of things.

With this simplification, the relationship between the load current and the capacitor size is given by:

$$\text{Load current} = \frac{\text{V load}}{\text{R load}} = \text{CxdV x 100}$$

where:
V load = Load voltage, volts
R load = Load Resistance, ohms
dV = Ripple in volts
C = Capacitance in farads

Even this is a messy and confusing formula. Fig 4 gives it in graphical form. A simple way to forever remember how to calculate capacitor size is:

Use a 10,000uF capacitor and the ripple in VOLTS will equal the current in AMPS.

Use a 10uF capacitor and the ripple in VOLTS will equal the current in MILLIAMPS.

Double the capacitor to halve the ripple and so on. For instance, with our rule, a 5000uF capacitor gives us 1 volt of ripple at 500 mA, and so on. Rules-of-thumb like we are giving you may not be exactly accurate, but they are quick, easy, and they work. And that's all we need to worry about.

The choice of a capacitor isn't too hard to make — use the best quality electrolytic you can afford, of a voltage rating at least equal to, and preferably double your output voltage. Ordinary high grade aluminium electrolytics are a good choice. Tantalum capacitors are an expensive luxury unless you happen on to some surplus units or are going to put your circuit into orbit. Silicon power diodes are tough and readily available. Use the BY126 or EM400 or their equivalents for the 1-amp or less applications. For higher currents, use automotive diodes or something larger.

These diodes run very hot. Their leads should be short and routed to some sort of heat radiator such as lots of foil on a PC board, or a large terminal strip. The heat removal process is mostly by conduction —

TABLE I
SOME LOW COST AND EASY TO USE VOLTAGE REGULATORS

(Typical unit pricing on these run from $2 to $4.)

7800 Series	Fixed voltage, positive only. To 750mA without extra parts. 7805 is 5V. Also available as 6V (7806), 8V (7808), 12V (7812), 15V (7815), 18V (7818) and 24V (7824).
	Data Sheets from FAIRCHILD Australia distributors in all states.
	or MOTOROLA SEMICONDUCTOR distributors: Total Electronics Pty Ltd.
7900 Series	Fixed Voltage, negative only. Similar to above.
LM309K	Fixed voltage 3-terminal regulator (5V) similar to 7805, in metal TO-3 package. Data sheets from NS ELECTRONICS Pty Ltd or their distributors in each state.
723	Adjustable voltage regulator with adjustable internal current limiting. Output may be set to between 2 and 37 volts, current to 150mA or higher with external series pass transistor. Positive or negative supply operation. Line and load regulation .01 per cent. Data sheets from Fairchild or NS Electronics distributors.

Design an IC supply

out the leads. For long diode life, provide some place for this heat to go. Phenolic PC boards may char under direct heat exposure, so the epoxy-glass versions are preferred for power supply work. Also be sure that a power diode doesn't end up in direct contact with an electrolytic capacitor, or the heating can shorten the capacitor's useful life.

The maximum voltage across the diode is twice the output voltage. Use a PIV rating at least double this. If in doubt, go to a 200- or a 400-PIV unit; they don't cost that much more and may be easier to get.

This brings us back to the transformer. If you possibly can, use a stock filament transformer, as these are inexpensive and easy to get. Unfortunately, these often turn out to be rather large, particularly if you are working with compact gear, and offer only a limited choice of voltages.

The input fuse and third wire ground on the supply is simply good practice. If "slow-blow" fuses are available, use one whose amperage is above 1 / 100th the load power. For instance, a 5-volt, 1-amp unregulated supply provides 5 watts at full load. Use a 5 / 100 — 0.05 ampere unit. The actual current may be found by dividing the load power and the transformer losses by the line voltage, making some power factor adjustments and then adding a safety factor. The 1 / 100th load power current (measured at the capacitor — not the regulator) formula is a lot quicker and gives the same result.

If only standard fuses are available, use at least the next size up — ie, in the above example, a 100mA fuse would be appropriate.

Fig 5 shows a dual unregulated power supply, where we have added two more diodes and a new capacitor to pick up a negative voltage. You might like to use only the bottom half of this circuit if you need a negative-only supply.

By now, we should know how to design a power supply that has a given output voltage and a given output ripple. All we have to do now is add a regulator.

Fig 6 shows how a typical positive-only regulator may be added. The regulator senses the output voltage and then absorbs the difference between the instantaneous supply voltage and the desired output. The minimum extra voltage you can live with is called the dropout voltage, and is typically 2 to 3 volts above the regulated output voltage. Thus most 5-volt regulators need at least 8 volts to work with.

The maximum permissible input voltage is usually set by a breakdown limit and the allowable internal power dissipation. The load current times the extra voltage drop must be internally dissipated by the regulator. This is determined by the size of the regulator, the load, the available heat-sinking, and whether external pass transistors are used with the regulator.

Several add-ons normally go with the regulator circuit. An output capacitor, usually in the 0.1 to 1uF range is almost always needed for regulator stability, and it has to be a good Mylar or tantalum capacitor. The current-limiting circuitry may be internal, or you may have to add a chosen resistor to get a desired current limit. You may be able to add a voltage or a

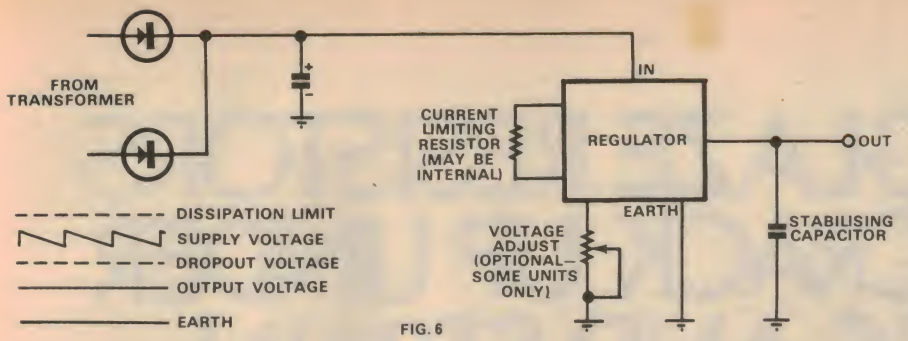


FIG. 6

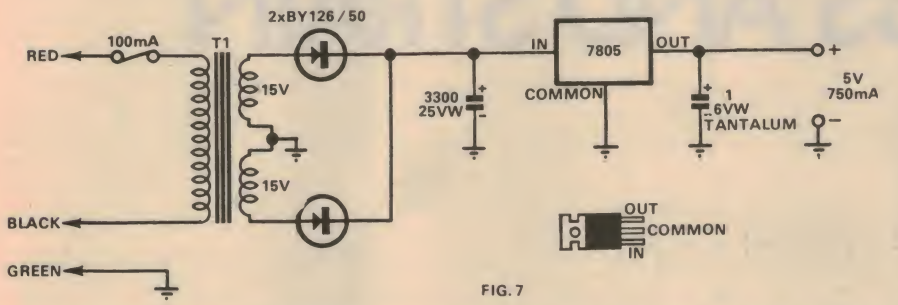


FIG. 7

GENERALISED IC REGULATOR is shown in the diagram at top, while a practical 5V / 750mA supply is given below it as an example.

resistance to change the output voltage, and finally, you may be able to add external transistors to extend the current capability.

Regardless of what regulator you use, be sure and have a data sheet on hand and study it carefully. Most regulators need at least one stabilising capacitor on the output. Almost all of the newer ones are very easy to use, but you must sit down with the individual data sheets to make sure you aren't exceeding a limit.

Several popular low-cost regulators are shown in Table I along with their manufacturers. Prices range from $2 to $5 if you pick the room-temperature versions and the economy package. Most data sheets have extensive applications and design information attached to them. Once again, don't try to do any regulator design without a specific data sheet on hand, for there are lots of differences between apparently similar devices.

The best way to show you how to design your own regulator circuits is with a quick example.

The example is a 5V logic supply to deliver up to 750mA (see Fig 7). For this I have elected to use the fixed 7805 positive regulator. (The LM309K would also be suitable.)

It internally current limits at 750mA and should be just what we need for a TTL or DTL system power supply. The dropout voltage is 2 volts. The maximum power dissipation at room temperature with a good heatsink is slightly over 5 watts. This means the maximum permissible voltage across the regulator is 5 / 0.75 = 6.7 volts. For this circuit, the permissible range of supply voltage is then 7 to 11.7 volts. Let's aim for a 10-volt supply with 2-volts worth of ripple, splitting the difference on both ends.

First, our capacitor size. A 10,000uF capacitor and 1 amp would give 1 volt of ripple. Similarly, reducing capacitance and current by one-quarter would still give 1 volt of ripple, or 7500uF for 750mA. Halve the capacitance for double the ripple, or 3750uF for 2 volts of ripple. We can probably cheat just a bit and get by with a 3300uF 16-volt electrolytic.

Output voltage at the capacitor, in absence of ripple, should be 10 volts. Add a volt for the diode to get 11 volts. Multiply by 0.707 and get 8 volts. Double this for a 16-volt centre tapped transformer. We therefore need a 16-Vct transformer at 750mA.

We could probably cheat a little and use a transformer such as the Ferguson PL15 / 20 (formerly called the PF3597), with the two windings in series. At 750mA this will give about 15V output.

A high quality 1uF, 6-volt tantalum is used on the output for stability. The output power measured at the capacitor at maximum load is about 10 volts x 0.75 ampere = 7.5 watts. The fuse should be 7.5 / 100 amp = 75mA for a slow-blow type. A standard 200mA type would be an alternative. Load current limiting is automatic and internal. Any reasonable-sized standing-up type of heatsink can be used, or the regulator may be bolted to the case (be sure to insulate it!).

If we wanted a negative supply instead, there's several things we could do. If we only want a negative supply, simply call the +5V line "ground" and the common line "5" Note that if we do this, we don't use the transformer winding for any other voltages, positive or negative.

Another alternative is to turn the whole circuit upside down and use a negative regulator. Devices such as the 78N05 or the 7905 have been announced and should be readily available by the time you need them.

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Circuit & Design Ideas

Interesting circuit ideas and design notes selected by the Editor from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsiblity cannot be accepted. Contributions to this section are always welcome.

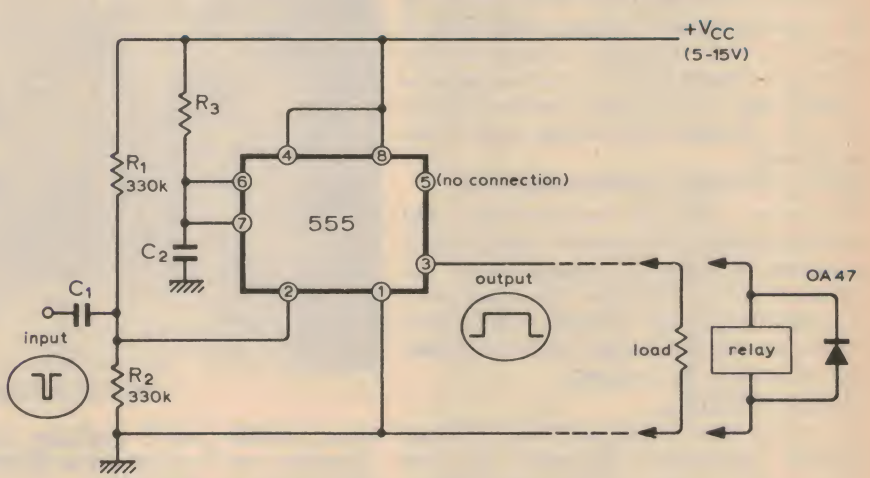
Simple pulse shaper or relay driver

To obtain pulses of a required duration and constant amplitude, one would normally use a monostable circuit. In most cases a simpler circuit can be made using the economical Signetics 555 integrated circuit. This device can provide output pulse currents of up to 200mA and can drive a relay directly from input pulses which may have a duration of less than a microsecond.

The circuit shown uses the 8-pin dual-in-line NE555V or the equivalent TO-99 type NE555T. It provides output pulses of a duration equal to 1.1R3C2; this can range from microseconds to many minutes, but R3 should not exceed 20M. Output pulse amplitude is a little less than Vcc, the exact value depending on output current. Rise and fall times are about 0.1us.

In the circuit, the input pulse amplitude must cause the voltage at pin 2 to fall to Vcc / 3 or less. Inclusion of R2 reduces the required amplitude of the pulse considerably. The value of C1 should be chosen so that the input time constant is appreciably greater than the fall time of the leading edge of the input pulses to minimise pulse attenuation. The 555 can be triggered by a current of 0.5uA from pin 2 for 0.1us.

The 555 operates with negative-going trigger pulses. If positive-going pulses with a steep trailing edge are available, the 555 can be triggered on the negative-going trailing edge. However, the use of positive-going pulses results in the output being delayed until the trailing edge of the input



pulse occurs; with wide input pulses this may be unacceptable.

To operate a relay directly, the relay coil may be connected in place of the load, in which case an input pulse causes the relay to close for a time 1.1R3C2. A diode must be connected across the relay coil to suppress transient voltages developed across the inductive load when the current in the coil is switched off. Such transients may damage the 555 and they have been found to cause automatic re-triggering of the circuit as a result of pickup. If re-triggering occurs, the relay fails to open. Not all types of diode give adequate suppression to prevent re-triggering; I found the gold-bonded types (such as the OA47) suitable.

If the relay and diode are connected between pin 3 and +Vcc, the coil will normally be energised, but the relay will be opened for the pre-determined time when the input pulse triggers the circuit.

The relay should be rated to operate from a potential approximately equal to that used for Vcc at a current of not more than 200mA. A small electromagnetic counter could be used instead of a relay.

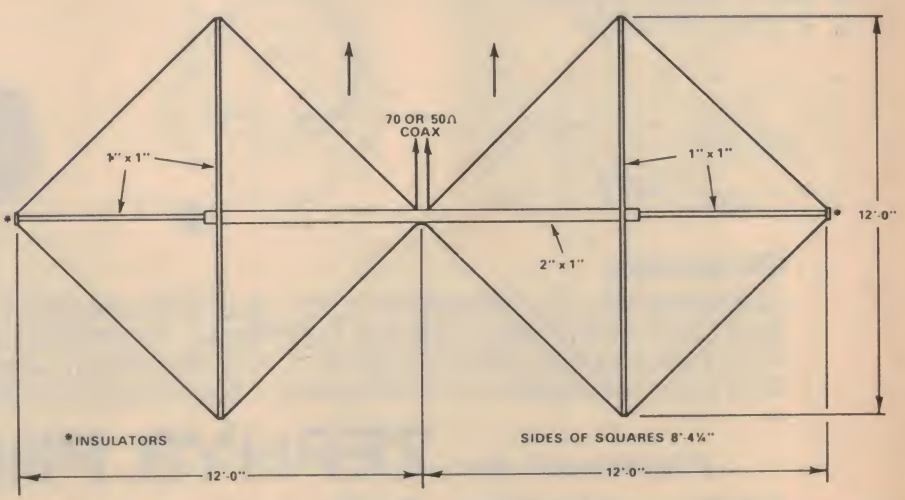
(By J. B. Dance, in "Wireless World.")

The Bow-Tie mono-band beam

In Circuit & Design Ideas for October, 1973, the VK2ABQ Triband Beam was described. Since then, I have been conducting further experiments and the outcome is the Bow-Tie mono-band beam. For those who want a quick and easy and lightweight beam for one band, here are details of a 20 metre beam which can be built of light timber, wire and nails. It has a back-to-front ratio of about 20dB and a gain over a dipole of about 6dB. A full scale unit has been built and fully tested at the home of a friend and a model for reception on 144MHz has also been made.

A timber frame is made up consisting of one 12ft length of 2in x 1in, two 12ft lengths of 1in x 1in and two 7ft lengths of 1in x 1in. The main boom consists of the 2in x 1in piece in the centre, with it extended 6ft each way with the 7ft lengths of 1in x 1in. Six feet in from each end of this assembly, a 12ft long cross piece of 1in x 1in is fixed.

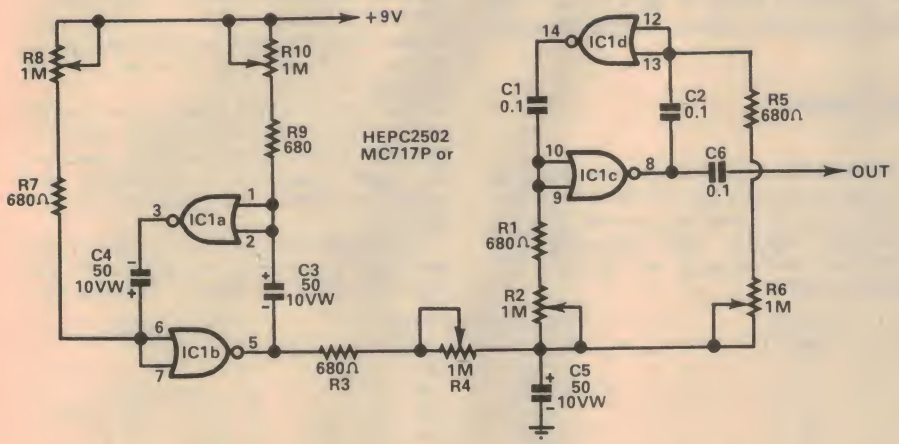
Two lengths of insulated wire, each 33ft 5in long are fitted as shown in the diagram. Small close-spaced insulators are used at



each end and the driven element is also broken in the centre with an insulator. The beam may be fed with either 70 or 50 ohm coaxial cable.

(By Mr F. Caton, 1 Mills Street, West Merrylands, NSW 2160.)

An electronic siren



Whether for sound effects purposes or for use in a theft alarm system, a great many experimenters have tried to make the electronic equivalent of a police siren. Many designs have appeared in the past but very few can match the range of adjustability provided by the one shown in the diagram.

The heart of the electronic siren is a quad two-input gate MC717P integrated circuit. The four gates are used in pairs to make two oscillators. One oscillator varies the frequency of the other.

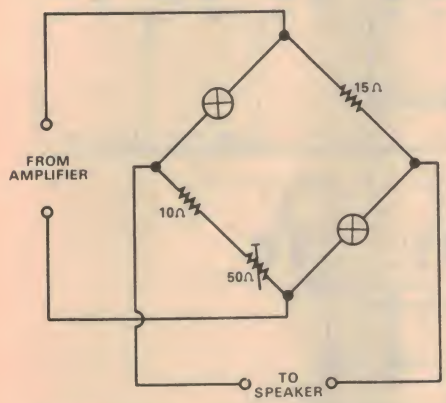
Assembling the electronic siren is a straightforward procedure. You can use a printed board of your own design, or you can use perforated board, etc. It is a good idea to use a socket for the IC. Do not try to solder the interconnecting wiring directly to the IC leads. Also, during assembly take care to properly index the IC and observe the polarity of the electrolytics.

After the circuit is assembled, connect its output to the input of an audio amplifier. Turn on the system and familiarise yourself with the effects each potentiometer has on the sound you hear. Setting all pots to mid-position should yield a sound much like that of a police siren. In fact, as you experiment with pot settings, you will find that this circuit will do a lot more than give just siren sounds.

(By Paul Eisenbrandt, in "Popular Electronics.")

Editorial note: We understand that Kitsets Australia Pty Ltd have stocks of the MC717P IC and readers who have difficulty in obtaining supplies from their normal sources should get in touch with Kitsets.

Simple volume compressor



With medium quality music reproducing systems, the details of very quiet recorded passages can only be heard by turning the gain control to a high value. However, louder passages will inevitably follow, also at the high gain. The listener's family or neighbours are often not so vitally interested in the music as to enjoy the ensuing blasts. A compressor is useful for limiting the louder passages, while allowing the desired gain for the softer passages.

A very simple compressor is shown herewith. It does not perform as well as the more complicated circuits (for instance, it is not as fast), but most listeners will find it to be adequate. At the correct setting of the variable resistor, this circuit limits volume peaks without being an intrusive presence.

The main circuit element is a pilot lamp which acts as a non-linear resistor. The effect is multiplied by making a differential comparison to a fixed resistance, using a Wheatstone bridge design. The types of lamps should be chosen according to whether the speaker is efficient or inefficient. For cases where less than one watt is dissipated in the speaker, the suggestion is to use a 2 volt lamp rated at 60mA, and a 2.5 volt lamp rated at 250mA.

Less efficient speakers can be handled by a pair of 2.5 volt, 250mA lamps instead of the above suggestion. For people who listen to several watts of output, 3.5 volt lamps rated at 250mA may be used instead. One of the circuits shown is required for each channel.

(By Daniel Shanefield, in "Audio".)

Makeshift test equipment

Since there are few tools and no testinstruments available at sea, I have often used a long-wire antenna as a signal generator. It works fine, even in the audio stages of a receiver. Ashore, an 80-metre (or shorter) dipole will work due to the multitude of stations.

If you have access to another receiver in good operating condition, it can often be used as a signal tracer if you turn the audio gain up — just clip a lead to the grid of the detector stage or to the RF end of the detector diode.

A receiver tuned to WWV or a multiplex signal, or beat against an internal crystal calibrator, makes a fine audio generator; just put a couple of clip leads across the speaker terminals. If you must know what audio frequency you are using, invest a dollar in a harmonica and mark the standard musical pitches on the blow holes with a sharp scribe.

(By Keith Olson, W7FS, in "Ham Radio".)

A quarter-stop photo timer

Following our description of a photographic timer in the May 1973 issue, there has been some general discussion as to the optimum order of time increments which are desirable and, at the same time, practical. Here is one reader's approach to the problem.

by V. E. CHADIM*

I would like to contribute some comments to the recent discussions on photographic timers, and to submit my version of a practical unit.

First, the mechanical design. I do not think rotary switches are particularly well suited to instruments used in the darkroom. Invariably they are a little stiff, and either the timer has to be bolted down, which is not always convenient, or one has to use both hands, one to turn the knob and the other to hold the timer.

(Editorial note. We agree that a timer which required two handed operation would be quite unacceptable but, at the same time, we must point out that this was not a problem with any of the timers we have described. The May 1973 unit used a modern miniature Oak switch with a single ball bearing indexing mechanism, and a very light action. Older style switches can be given a lighter action by removing one of the two ball bearings normally used.)

An alternative is the Isostat series of push button switches, marketed by McMurdo, which are just about ideal for this purpose. Any combination can be assembled on the same mounting bar; a mains on/off switch, interlocking push-buttons serving the time constant selection, a push-on/push-off switch for the focusing light and a similar switch with the locking pin removed as a trigger push-button. These push buttons can be arranged in groups with gaps between them, or different shapes or sizes of buttons for different functions, so that their setting is easily detectable by touch and their illumination made unnecessary. This is a particularly important point for colour enlarging. Providing the buttons protrude through holes or slots in the upper surface of the case, they can be easily operated by one hand. All this for about 50 to 60 cents per push-button, with the exception of the mains switch which is a little dearer.

I completely agree with your correspondent (Mr P. Sanders, August, 1973) that 1/2 stop separation is too coarse. Even 1/3 stop separation may not be adequate for repetitive work on hard (contrasty) paper. It is possible to construct a timer with 1/4 stop intervals using only one more tantalum capacitor than did Mr Sanders. (Cost, 28c.) With standard component values, and disregarding the tolerances for the moment, the full stop and half stop settings are exactly right, the +1/4 stop is 0.42 per cent and the +3/4 stop 0.12 per cent off the correct design value.

Multiplying factors for half stop time increments are based on the square root of 2 (1.414) and for quarter stop increments on the square root of 1.414 (1.189). The actual factors to give three one quarter stop increments, together with the necessary capacitor combinations, are given in the following table.

"STOP" RATIO	TIME MULTIPLIER Exact	Actual	PARALLEL C (uF)
0	1.000	1.000	10
+1/4	1.189	1.194	10, 1, 0.47, 0.47
+1/2	1.414	1.414	10, 2.2, 1, 0.47, 0.47
+3/4	1.682	1.680	10, 6.8

This is the simpler of two suggested arrangements. It permits any selected whole stop to be increased by one quarter, one half, or three quarters. It uses one 7-button switch to select the whole stops, via a resistor network, and one 4-button switch for the fractional stop positions via the capacitor network.

The 4-button switch consists of 3 swirch blocks of 2 changeover contacts and one interlock release block without contacts. The 10uF capacitor is connected permanently in circuit next to the NE555 times (Fig 1).

The second arrangement is rather more elaborate. It permits any selected whole stop to be either increased or decreased by one quarter, one half, or three quarters. It is more demanding in terms of the second

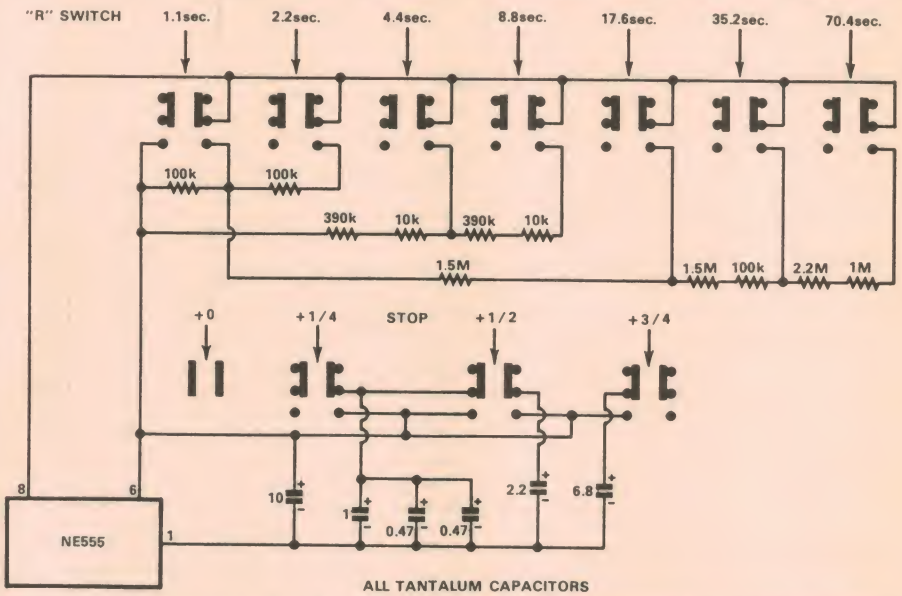


Fig. 1. This is the simpler of two suggested arrangements. It provides for quarter-stop steps above any selected whole stop. It uses a simple switching network and should take care of most printing situations.

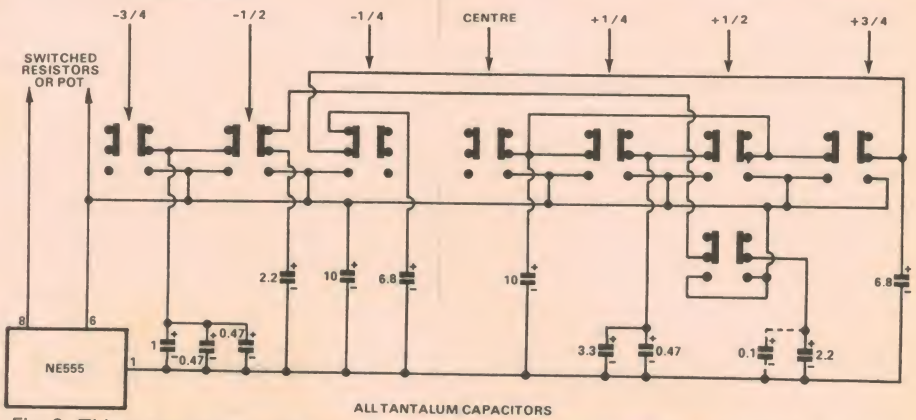


Fig. 2. This is a more complex arrangement. It provides for quarter -stop steps both above and below any selected time. It is useful where a pot is substituted for some or all of the whole stop switched resistors, as explained in the text.

* 8 Parker St, Curtin, ACT, 2605.

switch — 7 push-buttons, one of them (the "plus ½") a 4 pole change-over type.

Against this, the "Whole stops" switch does not need the last push-button (the one adding 3.2M). If an occasional longer time is needed, the trigger could be pushed twice in succession.

The time multiplying factors to give the seven quarter stop increments, together with the necessary capacitor combinations, are given in the following table.

"STOP" RATIO	TIME MULTIPLIER Exact	Actual	PARALLEL C (uF)
—3 / 4	1.189	1.194	10, 1, 0.47, 0.47
—1 / 2	1.414	1.414	10, 2.2, 1, 0.47, 0.47
—1 / 4	1.682	1.680	10, 6.8
centre	2.000	2.000	10, 10
+1 / 4	2.378	2.377	10, 10, 3.3, 0.47
+1 / 2	2.828	2.827	10, 10, 3.3, 2.2, 2.2, 0.47, 0.1
+3 / 4	3.364	3.360	10, 10, 6.8, 6.8

This arrangement is really a bodily movement in an upwards (time) direction of the simpler system. The centre position doubles the capacitance used for the whole stop position in the first system. Thus, without any modification to the resistor network, this capacitor network makes all times longer by one stop.

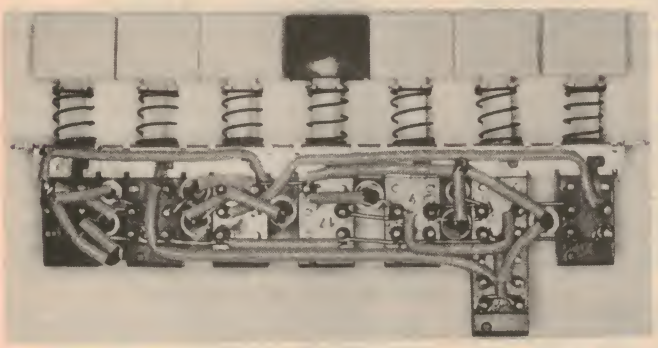
The main justification for the second approach is to permit replacing the resistor network either entirely or in one switch position (the seventh push-button) by a potentiometer, calibrated in seconds. This could be useful for those who have some sort of darkroom exposure meter, similarly calibrated. The time read off the meter is then set by the timer potentiometer, and a test strip is exposed and developed. With a little experience it is quite easy to judge whether the picture needs a 1 / 4 stop more, 1 / 2 stop less etc, which can then be set by the capacitor push-buttons without touching the potentiometer. This is the reason for providing both plus and minus variation. Potentiometers, unless they are of the expensive multiturn variety, are difficult to set or reset exactly in the dark, and any corrections are better made by the push-buttons.

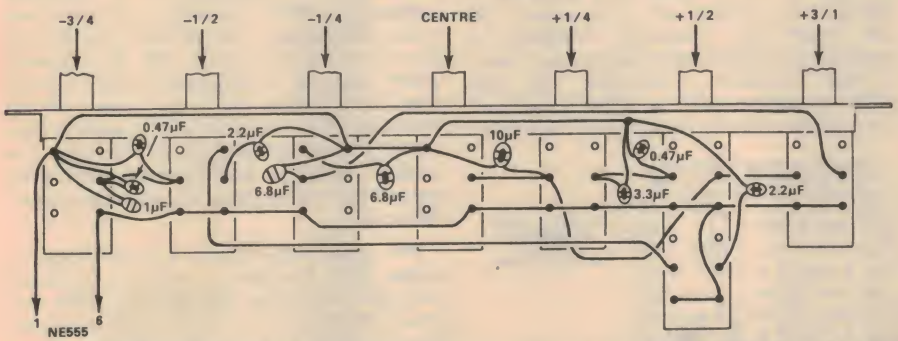
A total of 12 tantalum capacitors are shown but, if the highest of the three 0.47 capacitors is selected for the —+1 / 2 position, the 0.1 capacitor may be left out (as it was in my case). The "ELNA" brand tantalum capacitors fit between the switchblocks at 15mm spacing, but would be more comfortable in the next larger, I think 17.5mm, spacing. The 10 microfarad capacitor permanently wired in the circuit is not shown in the photograph.

Having heard disparaging remarks about the tolerances of electrolytics in general and tantalum capacitors in particular, I bought one more than I needed of each value with the intention of selecting those which would mutually compensate their inaccuracies. I was amazed to find that this was not essential. Even without any selection the tolerances were quite acceptable, and with a little juggling of capacitors I was able to set the times to within 3 per cent, using Elna tubulars.

The selection is quite simple, the timing resistor is temporarily replaced by a potentiometer and large resistor, set to give 100 seconds with a 10 microfarad capacitor. Additional capacitors are then connected by means of alligator clips on a trial-and-error basis, and the resulting times noted. In the same way the resistors can be selected later from 5pc tolerance types.

I had to do several hundred pictures on hard paper recently, and I cannot see how I would have managed without the 1 / 4 stop interval timer. It is still not fine enough for extra hard paper, but this can be overcome in the infrequent cases when such paper has to be used by giving the print 2 exposures, the normal one on the low side and an extra one 3 stops down, representing an additional 1 / 8 stop.





A photograph (left) and diagram (below) showing the layout and wiring of the seven section switch used for the circuit of Fig. 2. Note the capacitors between the switch blocks.

Breadboard Hookups — 1974 Style

Elementary Electronics

by Ross Tester

This month we are updating an earlier article, containing six low-cost, easy-to-build projects, which should especially suit "Elementary Electronics" readers. Not only will you have no trouble making them, but they are all useful devices in their own right.

When this article on "breadboard" hookups was published back in March, 1966, it proved very popular. Not only did it provide the opportunity to build simple and economical projects, but it gave good practice in using a (then) new constructional aid — Veroboard.

Times have changed: Veroboard has become accepted as the basis of many "one-off" projects, intended for the home constructor. Times have also changed in the components field — so much so that many of the devices used in the original "breadboard hookups" are variously hard to get or completely unobtainable.

For this reason, we thought it would be a good idea to re-publish the breadboard hookups as a batch with modern circuitry and components. If some of the circuits look familiar, it is probably because you have seen them before in Elementary Electronics. Even so, we feel there is an advantage for newcomers in having them all in one handy group.

So here they are: Breadboard Hookups, 1974 Style . . .

1-Crystal Set Amplifier

This one stage audio amplifier should be of particular interest to those who have a simple crystal set and wish to hear stations with increased volume in the headphones.

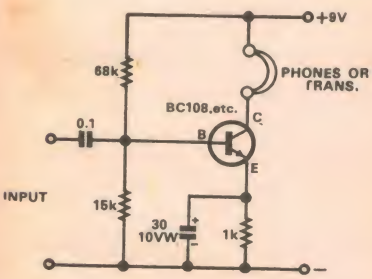
There are two advantages in adding an audio stage to a crystal set. The first, and most obvious, is the amplification of signals to a more comfortable listening level. The second, although not so obvious, is an improvement in selectivity; this may be obtained by reducing the aerial coupling, achieved by tapping the aerial further toward the earthy end of the coil.

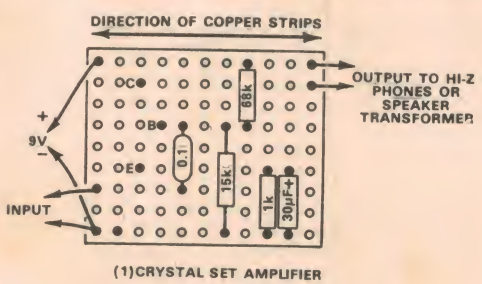
This reduces the load on the tuning coil, enabling it to achieve a higher "Q," the major factor governing selectivity. Since the headphones also load the coil, a further improvement should result by reason of the higher input impedance of the amplifier, compared with most headphones, particularly the low impedance types.

The circuit uses a single BC108 or any similar small signal NPN transistor. Output from the collector circuit may be into a set of high impedance headphones, or a small valve-type output transformer. We have used the transformer idea a lot recently, as it side-steps a supply problem with old-type 2000-ohm headphones. It enables a set of modern "hi-fi" type phones to be used, with an added advantage of high sensitivity and better comfort.

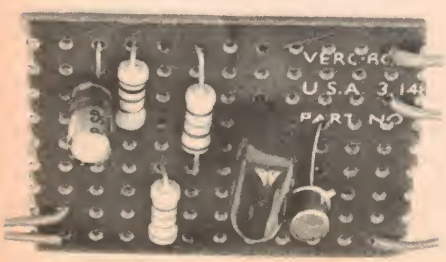
Signal to the amplifier is applied to the input capacitor and earth. In exceptional signal areas, a 10k volume control could also be used. The transistor is biased by the two resistors connected to the base and by the bypassed emitter resistor. (For more information on this particular circuit, refer to Elementary Electronics in the December 1973 issue).

The input capacitor is shown on the circuit as a 0.1uF type, mainly in the interests of economy. The circuit will work as it stands, but a higher value capacitor will give better low frequency response — particularly if good quality phones are used. A small tantalum electrolytic, say 1uF 10VW, could be used, with its "positive" lead connected to the base of the transistor.





(1)CRYSTAL SET AMPLIFIER



1 x BC108 or similar transistor
1 1k resistor
1 15k resistor
1 68k resistor
1 0.1uF capacitor (see text)
1 30uF 10VW electrolytic capacitor
1 piece Veroboard, 0.2in pitch, 37 x 45mm.
9V battery, hookup wire, etc.

2-An Impedance Matching Device

Our next project is a one transistor impedance matching device which has a number of useful applications in audio circuitry.

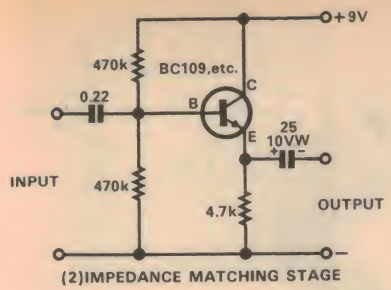
The matching of high impedance sources to the input of valve circuits is reasonably easy to achieve by design, and in fact, input impedances up to the order of 10M are possible. In the case of transistors, high input impedances are not a natural characteristic and it is not so easy to match high input impedance sources to transistorised circuits.

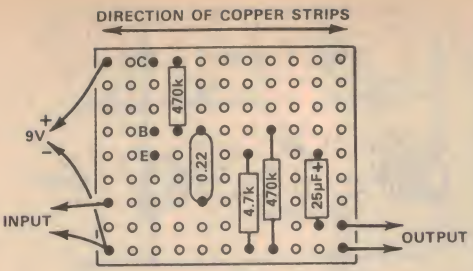
To overcome this problem an impedance matching device is required. This is where our little unit finds its use, for it is capable of matching a high source impedance to a low input impedance. This does not imply that it is restricted to transistorised circuits, because not all valve circuits have high input impedances. It can be used equally well for matching into low impedance input valve circuits.

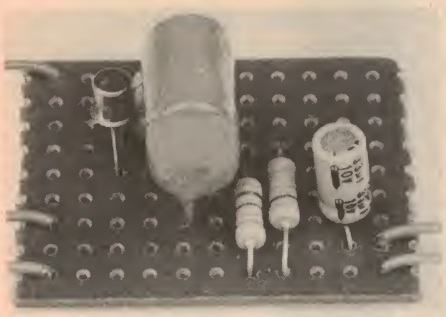
The circuit, using a BC108 or similar NPN transistor, is connected as a common collector, emitter follower, and operates from a 9V supply. The voltage gain of this device is less than unity. For this reason, there must be a sufficiently high level of signal available from the source being matched to ignore the lack of gain of the circuit. The signal is applied to the base via a .22uF capacitor, and the output extracted across the 4.7k emitter resistor via a 25uF capacitor.

The input impedance of this circuit is about 220k. Frequency response is better than plus or minus 2dB between 20Hz and 20kHz. With a 10k load in the output, a signal input level of 1.5V can be handled without the circuit clipping, this effect actually occurring at approximately 1.7V. With the output load reduced to 1k, clipping occurs at an input level of 350mV.

This project is not at all difficult to build and, as with all the others in this series, should prove interesting to both beginners and experienced constructors alike. The photograph gives a general idea of the layout, whilst the drawings give precise details of both the component layout and underside copper strip soldering points. One check that the circuit is functioning correctly is to measure the total battery drain, which should be approximately 0.9mA.







1 BC108 or similar transistor
1 4.7k resistor
2 470k resistors
1 0.22uF capacitor
1 25uF 10VW electrolytic capacitor
1 piece Veroboard, as above.
9V battery, hookup wire, etc

3-Two Stage Amplifier & RF Probe

This project, a two stage audio amplifier with volume control and supply switch, is a "big brother" to the one stage audio amplifier for crystal sets described elsewhere in this series. It is suitable for a wider range of applications, as we shall see.

One use for this amplifier is that of tracing signals in audio circuits, the input of the amplifier being connected across signal points in the circuit being examined. This enables the user to determine the presence, or otherwise, of signals at any given point.

For example let us assume that it is desired to locate a fault in an audio amplifier. The input of the test audio amplifier can be connected to the input of the first stage of the equipment being tested, where a signal should be heard if all is in order. This being so, the signal tracer can then be connected to the input of the second stage, and so on towards the loudspeaker until the signal cannot be heard. When this has been determined we know that the fault lies between that point and the last testing place where the signal was heard. A thorough examination of the circuit between these two points should reveal the faulty component or connection.

It is also possible to trace distortion in audio equipment using this approach, the signal tracer indicating at which point in the circuit the distortion is occurring.

When the amplifier is to be used in this application an isolating capacitor of about .1uF, 400V, should be connected in series with the active input terminal (top of the 10k pot). Additional isolation can be provided by adding a resistor in series with the capacitor, say 10k or as much higher as can be tolerated without serious loss of gain.

The sensitivity of this amplifier is such that it may be connected directly to tape heads, microphones and pickups to check their outputs. However, there are no equalisation circuits in this amplifier and, where equalisation is necessary due to the recording characteristics of either tape or disc, or where mismatch between pickup or microphone and the amplifier input suppresses the bass response, the overall balance may sound "thin" or "tinny."

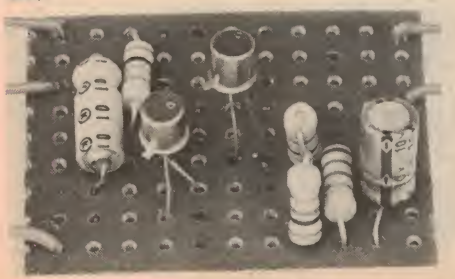
As it stands, this circuit can only be used for tracing audio signals. In order to trace modulated RF signals it is necessary to precede the amplifier with a detector or demodulator. Such a device is simplicity itself, and consists of only two components, as shown in the circuit diagram. The RF signal is applied across the OA91 or similar germanium diode via a .001uF capacitor, and, with the circuit connected to the amplifier, the 10k input potentiometer acts as the diode load. Such a piece of equipment is called an RF probe.

As the circuit contains only two components, it is possible to construct it in a number of ways as a small and handy item. Probably the most convenient method is to house the capacitor and diode in a hollow pen-like holder, such as the plastic case of a ball-point pen. Suitably cleaned, and with the components soldered to it, the metal part housing the actual ball-point becomes the probe tip with which to pick up signals whilst a flying lead may be taken away and connected to chassis, thus giving a compact and easy to handle unit.

The combination of RF probe and amplifier allows RF signals in radio receivers to be traced by merely connecting the probe between any desired point in the circuit, and chassis. In most cases it should be possible to trace the RF signal path for any discontinuity between the detector and the output of the converter. In fact, it is possible to detect strong local stations at the input of the converter.

As can be seen from the photograph, the components comprising the amplifier are easily accommodated on a piece of sample Veroboard. The drawings illustrate the layout used, and the soldered connections necessary to form the circuit in conjunction with the copper strips and components.

2 BC108 or similar transistors
1 1k resistor
1 1.2k resistor
1 10k resistor
1 100k resistor
1 10k log pot with switch
1 5uF 10VW electrolytic capacitor
1 30uF 10VW electrolytic capacitor
1 piece Veroboard, as above
9V battery, hookup wire, etc.
Probe:
1 OA91 or similar germainium diode
1 .001uF low voltage small polyester capacitor
Suitable housing (plastic ball-point pen, etc).



4-Multivibrator

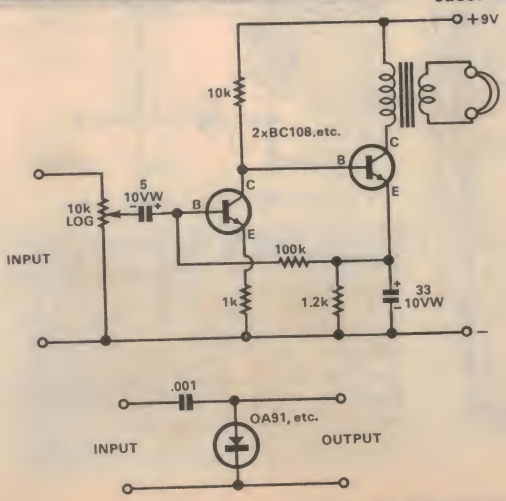
Our next project is a two transistor multivibrator. This has a number of uses in radio and electronics, as we shall see.

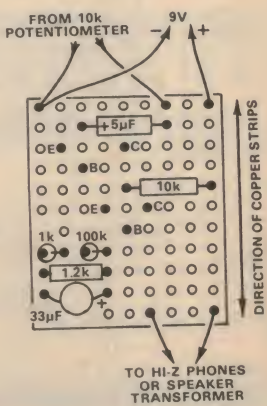
A multivibrator produces an essentially square wave output, and it can be shown that a square wave comprises a fundamental sine wave plus odd order harmonics which would extend to infinity with a perfectly square wave.

In practice it is impossible to achieve a perfect square wave output so the number of harmonics produced is finite. Nonetheless, output wave shapes very nearly square are possible, and the harmonics from an audio frequency fundamental will extend well into the RF region.

Thus, the harmonic output of a multivibrator may be used for testing or

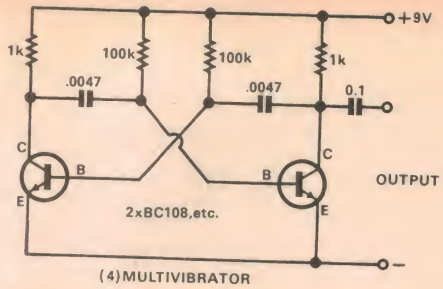
At left is the probe housed in a ball point pen case. The "works" fit in the barrel.



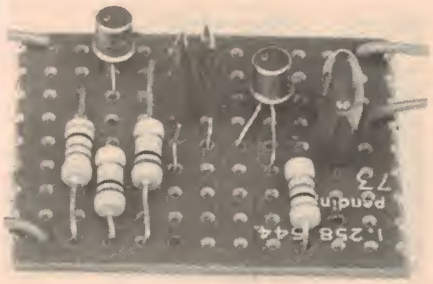


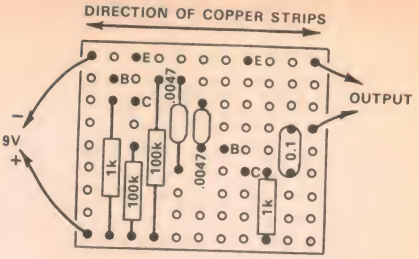
(3) 2 STAGE AMPLIFIER WITH RF PROBE

APR



(4)MULTIVIBRATOR





2 BC108 or similar transistors
2 1k resistors
2 100k resistors
2 .0047uF polyester capacitors
1 0.1uF polyester capacitor
1 piece Veroboard, as above
9V battery, hookup wire, etc

fault-finding, in either radio or audio equipment. In this role it is used as a simple signal generator and, with its output connected to the input of the equipment being examined, it will produce an audible tone in the loudspeaker, or headphones, if all is in order.

Ideally, we need a considerably more refined square wave generator than this simple device in order to conduct these tests properly. However, observations with this simple instrument can be a most instructive experiment.

The actual operation of this circuit is that one transistor is cut off while the other one conducts fully, this condition alternating between them at a rate determined by the value of associated components.

To trace faults in radio receivers and audio amplifiers, the best method is to start at the loudspeaker end of the equipment and inject a signal into the final stage. If a signal is heard in the loudspeaker, work toward the input, stage by stage, until no signal is heard. This shows at which point the equipment is faulty and a more localised and thorough examination around the stage should reveal the fault.

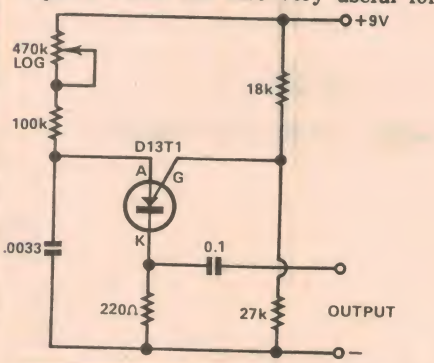
Square waves are also very useful for testing performance characteristics of audio amplifiers. If we start with a "perfect" square wave, pass it through an amplifier, then display it on a CRO, the resultant pattern will tell us quite a lot about the amplifier's behaviour.

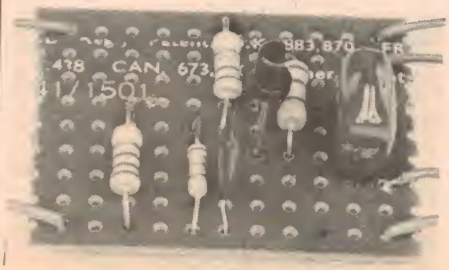
In general, there are three main amplifier characteristics which our square wave will check; high frequency response, low frequency response, and stability.

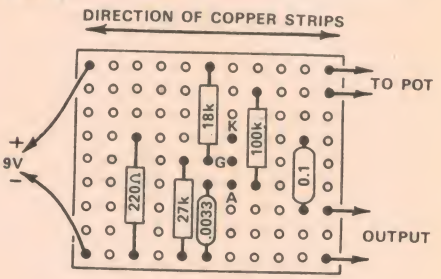
The frequency response may be only a rough check, since there are better, though more time consuming, ways of doing this. The stability check, however, can be most important. Where an amplifier has poor high frequency response, the "corners" of the square wave tend to be rounded, and an experienced observer can get quite a good idea of the degree of loss from the amount of rounding.

Poor low frequency response will be shown as an inability to preserve a level "top" to the wave, this being presented as an inclined plane. Once again experienced observers can quickly deduce the approximate order of loss.

Using the values shown in the circuit diagram, our multivibrator oscillated at approximately 7kHz. By feeding its output into the aerial of a communications receiver we found that the frequency range covered was from the broadcast band to 20MHz after which the signal dropped off rapidly.







(5) AUDIO FREQUENCY OSCILLATOR

1 D13T1 (2N6027) PUT
1 220 ohm resistor
1 18k resistor
1 27k resistor
1 220k resistor
1 470k log pot
1 .0033uF polyester capacitor
1 0.1uF polyester capacitor
1 piece Veroboard, as above
9V battery, hookup wire, etc.

6 — Mic. Preamp

Sooner or later, experimenters need to amplify the output from a microphone — a facility not always available even in many elaborate amplifiers.

Since cost often has to be considered, it is natural to ask whether an existing receiver or amplifier can be used for this purpose, by adding something to it. Depending on the individual's pocket, the microphone used could either be a crystal, dynamic, or even ribbon type, but since the dynamic type is capable of quite good performance at a very reasonable cost, it is a very popular and logical choice.

However, regardless of the type finally selected, the output will be very much lower than, say, that of the conventional crystal pickup, and will require considerable amplification before it is large enough to be fed into the pickup terminals of a standard audio amplifier.

Furthermore, if we happen to select a crystal type, it is essential that the input circuit to which it may be connected provide a high impedance, ideally about 5M but certainly not less than 1M. If it is otherwise, the bass response of the microphone will be seriously attenuated. Our simple pre-amplifier is designed to satisfy both these requirements.

The circuit may appear a little unconventional at first, and it may be helpful to discuss briefly some of its more important features. It is a two stage directly coupled amplifier, using an NPN (BC109) first transistor and a PNP (2N3638) second transistor.

Apart from the direct coupling, the main feature is the input circuit to TR3, designed to provide the high input impedance necessary for the crystal microphone.

The 220k resistor and the .22uF capacitor, connected as shown between the emitter and base, is known as a "bootstrap" arrangement, which has the effect of increasing the input impedance to a much higher value than that of the 220k resistor, by decreasing its shunting effect.

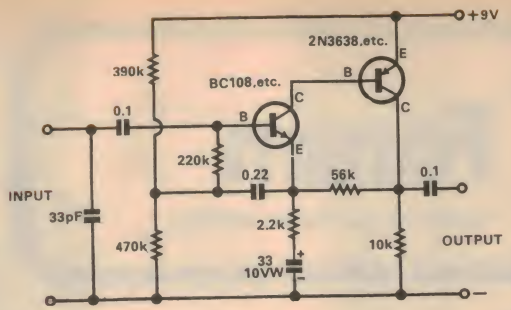
This circuit functions, broadly, something along the same lines as the emitter follower, in which a "bucking" voltage is applied to input load, so that very little current can flow through it from the signal source. Thus the source "sees" what appears to be a high-resistance.

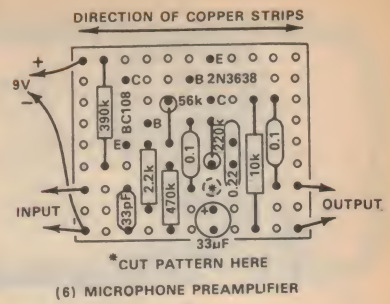
The 56k and 2.2k resistors provide both negative feedback and thermal stabilisation for the transistors. The 30uF capacitor supplies the AC path to chassis. The 10k to chassis is the collector resistor for T2, and the output developed across it is extracted via the 0.1uF capacitor.

This little unit performs very satisfactorily from a 9V supply.

Although there are a larger number of

(Continued on P 107)





(6) MICROPHONE PREAMPLIFIER

1. BC109 or similar NPN transistor
1. 2N3638 or similar PNP transistor
1. 2.2k resistor
1. 10k resistor
1. 56k resistor
1. 220k resistor
1. 390k resistor
1. 470k resistor
2. 0.1uF polyester capacitors
1. 0.22uF polyester or ceramic capacitors
1. 33pF polyester capacitor
1. piece Veroboard, as above
9V battery, hookup wire, etc.

5 — Audio Frequency Oscillator

The circuit at left is an oscillator, using only one active component — a PUT; or programmable unijunction transistor.

There are several uses for audio oscillators. One is a practice oscillator for Morse Code. Another is a buzzer for a door, or burglar alarm system. An advantage of this type of oscillator as a door buzzer is that, by using separate switches from the positive supply to the anode of the PUT, each with a different amount of resistance in series, each door push-button will give a different note — so you can easily tell which door you have to go go.

While the oscillator will produce audible output from a 15 or 33 ohm loudspeaker, headphones (8 ohm hi-fi types) are preferred because of their high sensitivity. A further advantage in using headphones for Morse practice is that the dots and dashes will only be heard by you — maybe you think that hours of Morse sounds fine, but we doubt if your family would agree!

For use as a door buzzer, the sound level into a speaker will not suffice, so an amplifier will be necessary. For more information, see our recent series on amplifiers.

The circuit is a conventional one, the PUT being connected as a relaxation oscillator. A detailed explanation of how it works is not within the scope of this article. Suffice to say that a relaxation oscillator operates by charging a capacitor to some critical voltage; the PUT then "triggers", discharging the capacitor, and the cycle is then repeated.

The frequency produced by the oscillator can be varied by means of a potentiometer included in the capacitor charging circuit. If a switch pot is used, this will save the expense of buying a separate switch.

The pot should ideally be an "anti-log" type — that is, an opposite law to a conventional logarithmic type. Alternatively, you can use a log pot with connections reversed, the only disadvantage being that at minimum rotation, the frequency will be maximum. If you are not worried about linearity, an ordinary linear taper pot will be quite acceptable.

As with all other circuits this month, the oscillator operates from a 9V supply. However, voltage is not critical, and other voltages, up to 18V, will be satisfactory.

Forum

Conducted by Neville Williams

Simple circuits can be really tricky

It's amazing how one can go on using circuits for years, and then suddenly discover that we don't really know how they work. The latest example is one which was highlighted in Letters To The Editor, November issue, entitled: "Cascode Problem". Not having an off-the-cuff answer, we left it open to see what would happen — and it did!

The circuit in question is the "cascode" RF amplifier, as commonly used in VHF receiving equipment. It had its heyday in wartime equipment, in post-war amateur band receivers and in the first generation of TV turret tuners. A typical circuit configuration is shown below.

A routine "how it works" explanation might run thus:

A triode valve has advantages over a tetrode or pentode as a first-stage RF amplifier, because it tends to yield a better signal / noise ratio. However, it exhibits a much higher plate / grid capacitance and this can produce instability when the grid and plate circuits are tuned to similar frequencies.

The problem is overcome in the cascode by effectively loading the plate output circuit with a very low impedance, represented by the cathode input circuit of the following grounded-grid stage. Because of the loading, the effective gain of the first stage is low enough for grid / plate capacitance not to be a problem.

In the second stage, the grid is itself grounded for RF, acting also as a shield between the input and output circuits. Operating into a tuned circuit, this second stage can provide high gain without risk of instability. The two stages in tandem can, in fact, provide at least as much gain as a high slope pentode with, usually, a better signal / noise ratio.

A refinement in the cascode circuit is a small inductor wired in series with the signal feed from plate to cathode. The inductor should be selected to suit the high frequency end of the range being covered. Proper selection of the inductor ensures maximum gain and best signal / noise ratio.

End of routine explanation!

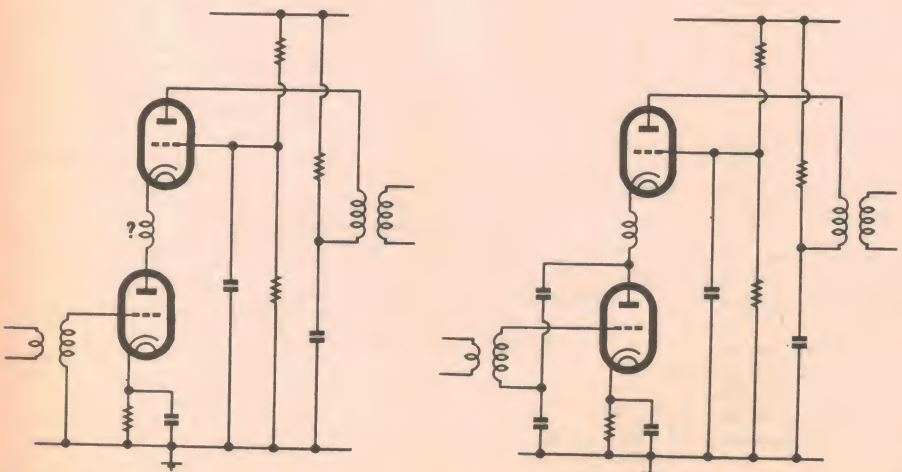
But what is the basic role of this extra inductor? That was the question raised by the correspondent in the November issue. He pointed out that it was regarded by some as a neutralising coil, but there were reasons for doubting this; others referred to it as a "peaking" coil, still others as a "matching" coil.

Does it, in fact, serve any purpose at all, since the cascode often seems to work just as well without it?

In reply to this, we acknowledge a letter from a Queensland reader, P.G., who has not the slightest doubt about its function. It is such a simple matter!

Dear Sir,

I refer to the problem relating to the inductor in the anode / cathode circuit of a typical RF Cascode amplifier. Ref: Letters to the Editor, Nov 73 and Jan 74.



At left, the basic cascode circuit and the "mystery" inductor. In many TV tuners the first triode is actually neutralised, as per the circuit on the right.

I am indeed surprised that no one seems to properly understand the purpose of this simple component. It is indeed to provide NEUTRALISING to the common cathode section of V1. The explanation is as follows:

As you will be aware, there are various reasons for using this type of circuit as opposed to a circuit using tetrodes or pentodes. The chief reason is, in a multiple grid tube, there is a greater disturbance to the electron flow in the tube due to the greater number of elements; this causes noise. In a triode the problem is considerably reduced.

(Also in the cascode circuit each half operates on about half the supply voltage, therefore less secondary emission and hence less noise again.)

What we have to face is that a triode amplifier has one serious disadvantage, that is the direct anode / grid capacitance, Cga. Where a wide-band amplifier is needed, as in a TV receiver, it becomes difficult to neutralise it properly and therefore to prevent instability. Also local oscillator radiation becomes a problem as it is effectively coupled via Cga to the input circuit and hence to the aerial to be re-radiated. A cascode amplifier largely overcomes these problems, as the second section which is the high gain section, is operated grounded grid, the grid actually performing the duty of the screen grid of a tetrode, pentode etc.

Yes there is a large miss-match of impedances between V1 and V2, but this is not so important, the V1 section supplying the necessary power gain to drive the low input Z of V2 cathode. But it still does have a voltage gain and therefore requires neutralisation. This is the purpose of the inductor.

Inanon reactive circuit Ea leads Eg by 180 degrees. However the anode circuit of V1 is purposely made inductive by this inductor; therefore Ea actually leads Eg by approx 270 degrees.

Now Cga is a capacitive reactance effectively in series with Zin as far as Ea is concerned. If the input circuit is properly tuned it will be a virtual resistor. Therefore the current through Cga leads Ea by a bit less than 90 degrees, and so E in the voltage fed back leads Ea by another 90 degrees — a total of 360 degrees. Therefore V1 is neutralised. Because Z Cga is much greater than R in, it won't be over neutralised; in practice slightly under neutralised.

P. G. (Eidsvold, Qld)

As you will have observed, P.G's explanation of the cascode expands somewhat on our typical "how it works" effort but he goes on to examine the phase relationships around the first triode. He shows that the voltage fed back from the inductively loaded plate will be approximately 360 degrees displaced from the input.

There is just one "detail" that he appears to have overlooked completely: Being displaced by approximately 360 degrees, the feedback voltage will be effectively IN PHASE with the signal. Far from neutralising the stage, the feedback will be positive or regenerative.

You can't have it both ways, P.G. If your phase analysis is right, your conclusion must be wrong. If your conclusion is right, then your analysis must be wrong. Back to the drawing board!

It is possible, of course, that P.G. is off the track altogether, despite his confidence about knowing the explanation for this "simple component". What if the feedback path doesn't really matter?

Let's turn to another letter, to see what I mean:

Dear Sir,

I refer to the correspondence regarding cascode amplifiers.

In the early '50s, McGraw Hill published a multi-volume report of design research carried out at the Massachusetts Institute of Technology during World War II, under the general title of "Radiation Lab Series". The series would almost certainly be contained in any good reference library.

One volume, entitled "Vacuum Tube Amplifiers" contains a most exhaustive analysis of cascaded triode amplifier circuits, including the "cascode" circuit.

The cascode consists of a grounded cathode stage driving a grounded grid stage and, basically, employs an untuned coupling. A particular merit of the circuit, other than the low noise inherent in triode amplifiers, is the very small feedback capacitance across the grounded grid stage, which removes the need for neutralisation around it.

The input impedance of the grounded grid stage is approximately equal to 1 / Gm, ie about 100 ohms for a valve with a Gm of 10mA / V. The voltage gain of the first stage, at low frequencies, is unity, viz: Gm x Rl — Gm x 1 / Gm.

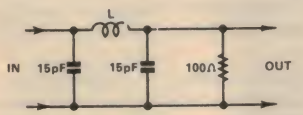


FIG. 1

Typically, the output capacitance of the first stage including strays is likely to approximate 15pF. Input capacitance to the second stage would be about the same. When directly coupled, the plate load of the first stage is therefore about 100 ohms in parallel with 30pF. As a result, the first stage gain will be about 3dB down at 50MHz.

By interconnecting the first and second stage with an inductor, the equivalent circuit is as per figure 1 and the terminated low pass filter so produced can exhibit a cut-off frequency approximately double that of the uncompensated circuit.

In fact, the technique is identical to the series peaking circuit commonly used in cascaded grounded cathode video amplifiers (Fig 2), except that video amplifiers are normally under-compensated to provide acceptable pulse response. This is not important in tuned amplifier applications.

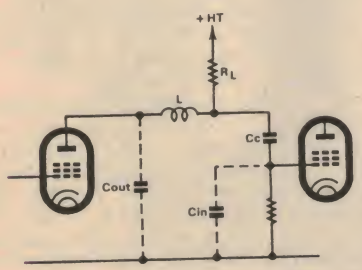


FIG. 2

In practice, in a tuned cascode amplifier, design departs considerably from that of a constant-K filter and the value of the inductor is decreased to increase circuit Q, thus peaking at the operating frequency and extending the HF performance.

This would hardly be of importance in the 50-100MHz region but would be noticeable at higher frequencies.

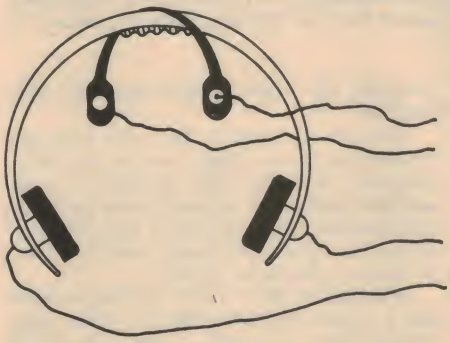
A HIFI BRAINWAVE. CRANIAL DIN PLUGS

April 1, 1974

Dear Sir,

I was delighted to read your enlightening article on "Headphones" in the EA of February, 1974. Unfortunately you have not elaborated about the use of quadraphonic equipment in relation to headphones. This lack of information, I take it, would be due to your ignorance on this particular subject.

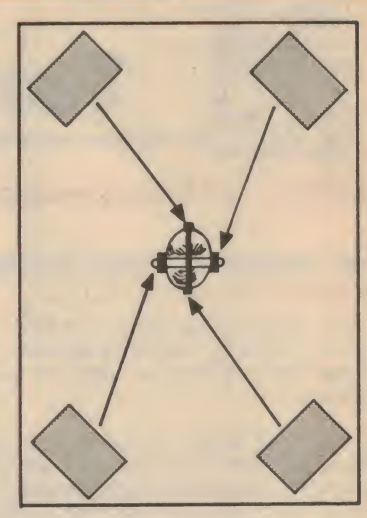
Let me, Sir, enlighten you on this problem which I am sure by now is baffling most of your readers who possess quadraphonic equipment. Along with an excellent sound system, I have a wife and five kids. Four of



the kids run around the house with a "tranny" strapped around their arms. The other holds a tape recorder in one hand and mike in the other demanding absolute silence when on a recording spree. Naturally my solution was the quadraphonic phones.

I duly purchased standard stereo phones and attached a new head band, centring it crosswise on the existing band. A pair of transducers 100 to 40,000Hz were then attached. (Any frequency lower than 100Hz applied in such manner is liable to cause severe headaches.)

One transducer rests squarely on the forehead. The rear one just at the base of the scalp. Unfortunately, padding on the transducers is out of the question as it causes considerable damping of the higher



frequencies. Damping is also caused by the hair at the back of the head. I solved this problem by shaving the area of contact. Incidentally the shaved circle will eventually become a status symbol.

Appended is a sketch of the quadraphonic phones and a diagram for rearranging the connections.

I cannot at this stage give any details of the transducer preamps as the whole gadget will eventually be covered by world patents.

As a point of interest to quadraphonic fans I would like to mention that I have been in contact with Professor Tunoerets of the Elektryczno Mechaniczny University in Europe regarding quadraphonic brain perception. He indicated that, at the moment, experiments are being conducted to graft sockets directly in the forehead and elsewhere around the cranium whereby audio signals from an amplifier can be fed directly to the brain via DIN plugs. This will eliminate the use of headphones and / or speakers for individual listening.

J.L.G. (Little Bay, NSW)

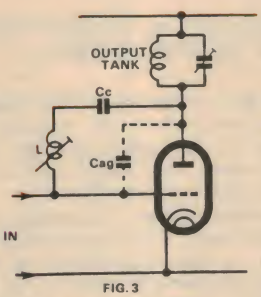


FIG. 3

In no way could the inductor be referred to as a neutralising component; it could be described as a peaking coil.

Perhaps confusion has resulted from the use of an inductor to neutralise a tuned amplifier, as in Fig 3. Here the neutralising inductor is in parallel with Cgp and produces an anti-phase feedback current in the grid circuit. Obviously L will resonate with Cgp at the operating frequency and neutralisation will be effective over a narrow band of frequencies. For this reason the circuit is not commonly employed, although shown for competeteness in circuit handbooks.

C.P. (Elizabeth, SA)

I think you will agree that explanation makes a lot of sense, with or without the support of the MIT literature.

1: It satisfies the observation that the inductor often "doesn't seem to do much". If the combination of tube characteristics and strays pushes the 3dB point out beyond the operating frequency, the inductor will not serve any particular purpose.

2: In the design of a TV tuner, the inductor can logically be arranged to support the gain at the highest frequency channels. At lower frequencies, support from a peaking circuit is not so necessary.

3. By optimising gain at the signal frequency, signal / noise ratio must benefit. Hence the routines for trimming the coil with this in view..

And this brings us back to the introduction. To look at, the cascode is not a very complex circuit. It has been used in, literally, millions of receivers. It has been mentioned countless times in literature and yet here we are arguing about how it works!

I wonder whether the argument has finished even now? I wonder how many other "simple" circuits there are that could be the subject of speculation, controversy and clarification?

The Serviceman

The know-all, the barber and the farmer

"The customer is always right": a phrase often heard in service organisations. But when the customer is right for the wrong reasons it doesn't do anything for a serviceman's disposition. Still, customer attitudes do vary and servicing does have its lighter moments, even if in retrospect.

One of the minor irritations one encounters as a serviceman is the customer who believes he knows exactly which valve or component has failed, and has no hesitation in pointing this out to the technician who is unfortunate enough to be handling his set. I can recall a number of cases where radio sets lacked volume and the owners insisted that the volume control be replaced. Their reasoning, apparently, was that, since this device controlled the volume, it must be the cause of insufficient volume.

As you have probably guessed, this little reminiscence was brought on by a recent incident. In this case it was a TV set and the owner insisted that the height control needed to be replaced.

Why?

Silly question — the picture lacked height, of course!

More precisely, it had been losing height slowly over a long period, making it necessary for the owner to re-adjust the height control at regular intervals to bring it back to normal. Eventually he had run out of adjustment and some time after that, with the picture getting shorter and shorter all the time, the picture started to fade, eventually vanishing altogether and leaving a black screen.

The set was an early model 23in of well known make, having the height pot as a user control on a bracket on the rear of the cabinet, along with the tone and vertical hold controls. I went to work with the VTVM and found the HT and B+ boost voltages to be normal, but that the voltage across the focus pot, and at G2 of the picture tube, was only 50 instead of about 450. Well, that was a good place to start.

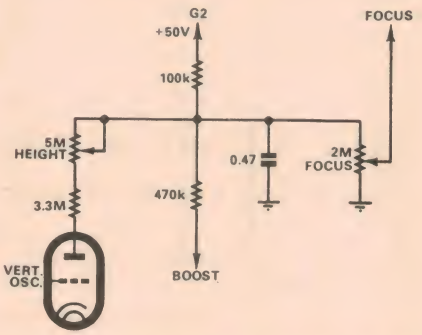
A quick resistance check across the focus pot showed only 50k instead of 2M; small wonder that the voltage was down. A number of possibilities presented themselves; the most likely being the focus pot itself or a .047uF capacitor from the junction of the height and focus pots to chassis. To determine which, I separated all three components at this junction.

First I measured the focus pot resistance. Aha, I thought, I have beaten Murphy at last; picked it in one. More precisely, the supposedly 2M pot read only 100k. While not unknown, it is unusual for resistors to decrease in value, particularly by such an order. I thought it might be due to a scrap of foreign matter which had found its way into the pot housing, so I attacked it with a pressure can of "Serviceman's Friend." Unfortunately, this had little effect, so I reefed the thing out and replaced it. Then I restored the other connections and switched on.

Well, it was better. The 50V had now climbed to 150; as I said, better, but still a long way from the 450V required. I made another resistance measurement from the junction to chassis and came up with 100k; again an improvement but a long way short of what it should have been.

Leaving the ohm meter across the focus pot I began disconnecting the other components one at a time. First, the .047uF capacitor, which had no effect. Then the height pot circuitry, whereupon the resistance jumped to 2M.

Which seemed definite enough, until I looked at the circuit again. The height pot was in series with a 3M resistor which connected to the plate of the vertical oscillator valve. How could such a circuit produce a 100k path to chassis?



Both control pots in the above circuit had developed high earth leakages.

Even assuming that the height pot had dropped in value by the same order as the focus pot — a rare coincidence in itself — one would also have to assume that the 3M resistor had dropped to a fraction of its correct value and that the vertical oscillator valve had developed an internal short. Since that would be stretching coincidence too far, there just had to be a simpler explanation.

I disconnected all leads from the height pot and made a few more resistance measurements, whereupon the riddle was solved. The height pot had a 100k leak to frame. And as I realised this, I realised that it could well be the explanation for the puzzling resistance drop in the focus pot. As I said before, a resistance drop of this order would be rare but a leak to frame would be much more likely, particularly as the height and focus pot were of the same make and virtually identical. Unfortunately, the focus pot had been irretrievably discarded by this time, so I could not confirm this theory. Nevertheless, I am convinced that this is the explanation.

A new height pot and everything came good. Everything, that is, except my disposition. For I suddenly realised that, for quite the wrong reasons, the customer had been right; the height pot was faulty.

When he came to collect the set he was quick to raise the point.

"Was it the height control?"

"The height control was faulty—"

"Ah! What did I tell you?" he cut in.

"— but so was the focus control."

I smiled ever so sweetly as I said it. I think he got the message.

To change the subject, one of the points I frequently make in these notes is the necessity for any serviceman to know exactly what kind of fault he is being asked to fix. I have emphasised that the customer should provide as complete a description of the symptoms as possible either verbally, if he deals directly with the serviceman, or via a note attached to the set if it is to be handled by a receiving clerk before reaching the service bench.

Nor do I have much regard for booking systems which make no provision for such messages to reach the service bench, or for service mechanics who make no attempt to obtain such information before they tackle a job.

In short, I suppose it amounts something of an obsession. Which probably means that the story I am about to relate represents some kind of gentle reprimand in case I am in danger of taking myself too seriously.

"Better hurry past the barber's shop this morning, dear," said Mrs Serviceman as I left for work on this particular day. Well, I can take a hint as well as anyone, and I had to admit that I was somewhat overdue for tonsorial attention. The trouble is, I keep putting it off hoping that tomorrow will be less busy than today. Of course it never is, and eventually I have to make time.

Thus it was that this morning I hung out the "Back in 20 minutes" sign, hurried across the road, and relaxed in the barber's chair.

"Short back and sides please George," I said, knowing full well that that would be all I would need to contribute to the conversation. George would have made an excellent politician; he invariably has all the country's problems solved every time I visit him.

He was ploughing manfully through the undergrowth with the clippers, and holding forth eloquently on the state of the nation, when he suddenly stopped both operations; the eloquence in mid sentence.

"Eh," he said, as though he had suddenly realised who I was for the first time, "you're just the bloke I want to see. My TV set . . ." (Oh blimey, I thought, can't I even relax in the barber's chair? Not that there was much I could do about it. A bloke in a barber's chair with his hair half trimmed is in no position to argue with the barber!)

"My TV set," he went on, "has a very funny fault."

"In what way?" I asked. (I felt I had to make some show of interest.)

"Well," he said, "it's a bit hard to explain."

He moved around in front of me, carefully put aside his clipper and comb, and adopted a very serious expression.

"You might be sitting down looking at a program see, and the picture's pretty good,

then all of a sudden it goes all funny."

I desperately wanted to ask what he meant by "all funny," but the seriousness of his expression forbade any interruption. He went on, "So you get up and adjust the knob" — his hand came up, fingers suitably cupped, and he adjusted an imaginary knob — "very carefully" — he gave the knob one final tiny movement to make sure it was spot on — "until you get a real good picture. Then, when you think you've got it just right, the bloke's face'll go like this."

And he twisted his face into a most grotesque shape, by moving his lower jaw as far to one side as he could. For want of a better description I can only say that it reminded me of the habit, portrayed by tough characters in American gangster films, of speaking out of the side of their mouth, supposedly to conceal the fact that they were speaking. Personally I always felt that it was about the best way to emphasise the fact.

"Then it goes like this." He swung his jaw over to the other side, dropped it slightly, gave a queer twist to the expression, then added a couple of twitches. The whole effect was so ridiculous that I was hard put to it to keep my face straight, particularly as he was deadly serious.

Finally I trusted myself to speak.

"It's an obvious case of line tearing," I said, trying to sound as matter of fact as I could, "but wouldn't like to say exactly what's causing it. Perhaps I could drop in some time and have a look at it."

So we left it at that. I relaxed again and George resumed his role of barber cum politician.

But on the way back to the shop I couldn't help speculating that I have been handed some strange and amusing explanations of set behaviour in my time, but this is the first time the fault has ever been enacted with facial expressions.

I just hope George's set never develops a case of gross vertical non-linearity. He could injure himself trying to portray that!

Finally, here is an amusing story from a country colleague in western NSW. I'll let him tell it in his own words:

A grazier brought his TV set into the workshop for an overhaul — the main troubles were snow in the picture and lack of width. Both the 6ES8 and the 6CM5 valves were weak and, after these were replaced and the various controls and adjustments given a touch up, the set performed very well. The customer collected it later that afternoon and was quite happy with its performance.

Unfortunately, the success was short lived. The customer rang the next day to say that the set was no better, and would I come and have a look at it. It was more of a royal command than a request and, since an unhappy customer is a bad advertisement, I organised things so that I could make a trip in that direction and attend to several other matters in the area at the same time. So, that afternoon, I headed for the bush.

When I eventually came face to face with the set, and the customer demonstrated its performance, I could see why he was upset. The picture was barely visible through a veritable snowstorm. It was obvious something was wrong, as the customer was in a fairly strong signal area.

The first thing I wanted to see was the aerial. So the customer obligingly showed me where it was — and to say that I was shocked is the understatement of the year. It was lying flat on an iron roof; no wonder the signals were weak.

Fortunately, I had a roof mount and a short length of mast with me and, after rigging the aerial correctly, the set performed perfectly.

When I queried the customer about the aerial he replied, "Well, the bloke I bought it orf told me to put it up on the roof — so that's what I did."

Now I've heard everything.

Letters to the editor

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

Fireproof TV cabinets

It was with interest that we noted on page 33 of your February, 1974, issue of Electronics Australia the introduction of a fire-resistant material used as the back of colour television receivers.

This article also reminded us of the evaluation of the flammable properties of some television receiver cabinets and other electrical goods on a Melbourne television program last year.

This company is the local representative and agent for a fire resistant reinforced PVC sheet known as DURAFORM. Compared to ordinary PVC or ABS sheet, DURAFORM Reinforced Sheet exhibits a high degree of resistance to fire in addition to providing considerably greater mechanical strength and low thermal coefficient of linear expansion.

Some three years ago, 1.6mm thick DURAFORM sheet was moulded and evaluated for use as a base of a locally produced television receiver. Although the finished article was satisfactory its cost was approximately thirty cents greater than its ABS counterpart. In relative costs this amount was small, especially if the improved fire resistance properties were a necessity.

To briefly summarise the properties of DURAFORM sheet, it is a reinforced PVC thermo-plastic sheet with high strength, corrosion resistance and fire resistance. DURAFORM sheet is available in a number of thicknesses and a range of pastel and bold colours; available also is black, white and grey. There is a choice of any colour on either face in either semi-matt or gloss texture, with either the usual flat surface or embossed pattern.

If you care to publish this letter, we would be pleased to service any queries received from your readers.

B. Hunt,
Technical Engineer,
Insulation Materials & Services Pty Ltd,
Box 56, Hawthorn, Vic 3122.

Electronic organs

I wish to congratulate you for the superb article on electronic organs in the February issue. Also the reviews on the organ records, which were well placed and most interesting. Both were first-class pieces of journalism and immensely readable.

I can't afford the high price of instruments in this class but I am interested in buying, or if need be, building an organ in the price range $1,500-2,000. I would therefore be very interested in a complementary article dealing with organs in the lower price ranges, to help in the selection of a suitable instrument. Even better, could you design a small instrument suitable for the local market?

G. J. Abbey (East Burwood, Vic).

COMMENT: We will certainly look into the idea of an article dealing with the less pretentious instruments, although the design information available on such instruments has tended to be rather limited in the past. As you probably know, we described a single-manual instrument some years ago with considerable success, but this is now obsolete and the parts would not be available. Lack of adequate componentry is a major problem nowadays, and this together with the relatively low price of commercial instruments makes it difficult to justify a "do-it-yourself" design.

Have calculator, will nitpick

With the advent of low-cost digital calculators freely available to the public, I imagine that there may be others like myself, who have nothing better to do than check figures which in the past one has taken for granted.

In my particular case I am unable to co-relate the attached calculations for the resistance of a certain piece of copper wire at a certain temperature.

I have selected 21 SWG, 21 BWG, 20 B and S, for my example, as it is a common size. The basic formula is from AS-C147.

No doubt you can shoot me down in flames, but I feel that you may like to show your readers how you are going to do this.

I. Geer (Moil, NT).

COMMENT: Unfortunately we don't have the time available to examine the calculations in great detail. However it seems likely that some of the sources of the figures you are comparing may be dated, in the sense that the numerical factors used may be related to earlier standards or definitions, This might well explain the differences involved. In any case your calculated 30.384 ohms per kiloyard figure for 21SWG copper wire is not drastically different from 30.39, 30.346 or 30.452 (the other figures), surely?

Record reviews

After reading your "Editorial Viewpoint" for January 1974, and realising the problems, or rather your problems, I am loath to voice my trouble — but I feel I must. It concerns "Record Reviews."

At intervals I pick out a record which appeals to me and I order same through my local outlet. I may never receive them. After some months, the final reply is "not available."

The last was from the January 1974 issue: The Great Serenades, Kenneth McKellar, Decca stereo SKLA-5160, reviewed by H.A.T.

I am advised it is not available, which advice I queried. A search of the EMI lists fails to reveal it. I am left with several thoughts: (1) It has been deleted; (2) It is a very new release; (3) It is not available to West Australia. There may be other possible explanations.

I note your remarks about tolerance and patience but I would like to know why.

A. C. Christensen (Geraldton, WA.)

COMMENT: We phoned EMI who advised that the album had definitely been released on November 15, which is about the time we would have been finalising reviews for the January issue. For reasons which were not immediately obvious, it has in fact been omitted from their lists. On the general scene, they explained that erratic vinyl supply makes it difficult to keep release announcements and stock in phase, while suppliers rarely stock the full catalogue range anyway. Perhaps W.A. poses special problems or maybe your local supplier is just "tired."

Abbreviations

I buy Electronics Australia every month and I think it's a first class publication. However I do have trouble reading some articles which include a lot of abbreviations such as SSB, BFO, AGC and so on. Would it please be possible to show what an abbreviation stands for, the first time it appears in an article? I am sure many beginners like myself would appreciate this, and gain even more understanding from reading EA.

R. G. Lethbridge (Toowoomba, Qld).

COMMENT: It is certainly possible, and in fact we started doing it many years ago. Unfortunately like many good ideas it can tend to be forgotten with changes in staff and the passage of time, and this is why you may have struck some unexplained abbreviations of late. We'll try to do better!

Home talkies from p29

a normal 50-foot cartridge is in use. The larger cartridge extends the filming capacity of the camera considerably, making it very suitable for TV work, education, business and industry.

To go with the Supermatic 200, Kodak will be making available 200-foot cartridges loaded with both silent and pre-striped film. The films which will be available are Ektachrome EF 7242 and Ektachrome SM 7244. Both films have a speed of 160 ASA (tungsten) and 100 ASA daylight when used with the appropriate filter.

And for those commercial users who need to do their own processing, Kodak will be making available a compact and fully automatic processor, the Supermatic 8. This is cartridge loading, accepting either 50-foot or 200-foot cartridges, and features a process time of 8½ minutes. A 50-foot roll is therefore ready for showing in only 13½ minutes.

With the needs of both amateur and professional taken care of so thoroughly by these new Kodak products, super-8 sound movies seem set for a glowing future. At the very least, these developments testify that super-8 film is still very much a strong contender in the world-wide "home video stakes".

They're talking about Capitol 2 recording tape

Musicians, hi-fi experts, music lovers of every kind are talking about the Capitol 2 cassette — the world's best iron-oxide tape. They're raving about the frequency response, (20Hz-20,000 Kz); the backcoating that makes the cassette jamproof; and the Stakpak — probably because it just happens to be the world's ultimate in cassette storage.

(Stakpaks come with 2 Capitol 2 cassettes that snap together like a chest of drawers — each with its own label).
Try the world's best iron-oxide tape.
And next time you hear someone talking about Capitol 2 . . . you'll know it's not just idle gossip.

Capitol 2

Gets the good sounds right.

EMI International leaders in electronics, records and entertainment.

Classical Recordings

Reviewed by Julian Russell

Quadraphonic sound — and the classics

TCHAIKOVSKY — Piano Concerto No 2 in G Major. (Complete Original Version). Slvia Kersenbaum (piano) with the French Radio Orchestra conducted by Jean Martinon. EMI Quadraphonic Q40ASD2825.

This is the first quadraphonic classic to come my way for review and I played it on stereo equipment because I have not yet acquired 4-channel sound and frankly see little chance of my doing so in the foreseeable future. But more of that later. In the meantime the disc under review bore the notice "The SQ record will be reproduced as 2 channel stereo when played through standard stereo equipment."

Played on my regular stereo equipment this particular example is anything but satisfactory. The reverberation period is so long that the recording sounds like it was made in an empty barn. The piano sounded all right in quiet passages but elsewhere twanged like a honky-tonk relic. The orchestra sound a little close — as heard in about the third or fourth row of a concert hall.

The playing is excellent, good technique all round, the juicy bits not overstressed. On stereo you might find the tone improved by a fairly heavy bass boost. To sum up, the playing all round, that of both soloist and orchestra has a refinement not matched in the engineering.

I think this is an appropriate time to have a look at quadraphonic sound and what it might mean to you personally. During my recent trip overseas, I found interest in it in England almost nil in the classical field.

In pops, the hysterically pitched advertisements describing the experience as "mind blowing" have persuaded people who admire electric guitars, and singers who scream tuneless words, to make the necessary investment. The distinguished English critic and record reviewer Desmond Shawe-Taylor, who was in Australia last year for the opening of the Sydney Opera House, told me during a brief conversation that he was totally opposed to 4-channel sound, chiefly because he didn't like music arriving at his ears from the back of his head.

I heartily endorse this view, despite the quad theories advanced that the same thing happens in a well-designed concert hall. The sound, this school argues, bounces back at the listener from the back and sides of the hall. This may be so, but whenever it becomes plainly noticeable to a critical listener, it means that either the hall is badly designed acoustically or else nearly empty.

To be immersed in a bath of sound is not the normal effect on a listener, though it may be that of the first flute and third oboe.

Now, recorded music is a matter of compromise. A moment's thought will make it clear that you cannot have an orchestra of 100 musicians blowing, banging and scraping away in an average sized room. Your ear—and the sound engineer—makes the compromise that enables you to IMAGINE that this is what you are listening to and this happens in the best modern examples of stereo with astonishing success. And at home, you still have the necessary walls for the sound to bounce off even though, as in a concert hall, it seems to originate in front of you. But this to me is only one objection to 4-channel sound. Others are more practical. Never mind what the adverts say, the addition of a little black box to your existing stereo equipment will not give you true 4-channel sound. To get the best effect from a quadraphonic record you must play it on true quadraphonic equipment and the only system so far to achieve anything like effective results for the classical buff is CD4 and the cost of this runs very high indeed.

True, you don't have to discard your patiently collected stereo library. Those discs can still be played successfully on a CD4 outfit. But how many people except the rich, will be prepared to rebuild their library with true quadraphonic records and buy the equipment necessary to play them as they were intended to be played?

In the December 1973 issue of the English "Gramophone" magazine the critic entrusted with the reviewing of classical quadraphonic discs, John Borwick, wrote that out of all the 4-channel records sent to him for review during the previous six months he could pick only one for "star billing" — the Ormandy / Philadelphia recording of Shostakovich's 15th symphony.

He goes on to mention another very interesting point: Boulez recorded the Bartok Concerto for Orchestra with the musicians seated all around him. And this, Borwick says, provides him with a "really exciting and I believe perfectly valid listening experience." Just how Boulez, placed as he was, succeeded in cueing in the various instruments without spinning round like the disc he was recording Borwick does not make clear. Did he avoid giddiness by reversing every now and again as in a waltz? Or did the musicians behind him have to guess his intentions by looking at the back of his head? I'd be intrigued to learn just how the exercise was managed in the studio.

It must be faced that even the CD4 system has not yet reached the stage of perfection necessary to encourage buyers to switch systems. And even if some are prevailed upon to do so by emphatic advertising of new wonders, does the limited repertoire available at present make the venture worth while? So my advice is don't rush into buying new equipment yet. And if you do decide to take the plunge first look carefully at your music room and work out where you are going to put four speakers, whatever size they might be. This last is a problem in no circumstances to be overlooked.

Mozart: "The Magic Flute" revisited

MOZART — The Magic Flute (Complete Opera). Franz Crass (Sarastro); Roberta Peters (Queen of the Night); Evelyn Lear (Pamina); Fritz Wunderlich (Tamino); Dietrich Fischer-Dieskau (Papageno); Lisa Otto (Papagena); Hans Hotter (Speaker); Hunert Hilton, Martin Vantin, Manfred Rohl (Priests); Hildegard Hillebrecht, Cvetka Ahlin, Sieglinde Wagner (Ladies) and others with the Berlin Philharmonic Orchestra conducted by Karl Bohn. DGG Stereo 2709 017. Three discs.

The current brilliant success in Sydney of the Australian Opera's excellent production of The Magic Flute, especially during the first performances which were conducted by Charles Mackerras, and the likelihood of its exposure to audiences elsewhere in Australia, prompted me to go back to the 1965 DGG recording of the work as just about the best I can recommend at present. Not that it is perfect. A perfect performance of The Magic Flute would be a very ususual occurrence anywhere at any time. I will not disagree with those who find especial merits in the earlier Klemperer set. I find them myself, here and there. But it is on a general balance that I prefer this recording — and by this I mean a balance of merits, not the balance of sound, which I must also mention as one of its recommendations.

I will start by stressing the three factors on which I base my preference — Bohm's elegant and bright handling of the score, Wunderlich's dazzling performance as Tamino, and Fischer-Dieskau's beautifully sung Papageno. Bohm's easy approach to Mozart reminds me of Beecham's, though Bohm perhaps wouldn't approve of all the wayward sprightliness indulged in on occasions by the latter. Maybe the description they share in common is "unforced." Bohm has a superb orchestra in the Berlin Philharmonic and though he might not always realise the grander moments of the score with the majesty of Klemperer, on the whole Klemperer elsewhere makes the lighter elements sound much much more heavy footed than does Bohm. Yet Bohm sacrifices no tension and keeps the whole ensemble on its toes from beginning to end.

I cannot describe Wunderlich's contribution except in superlatives which always make tiresome reading. Both musically and dramatically it is, for my book, an ideal performance. His voice has rare beauty throughout its wide range and he reaches even the highest notes without impairing its perfection. I know of no tenor singing at present who could successfully challenge this performance.

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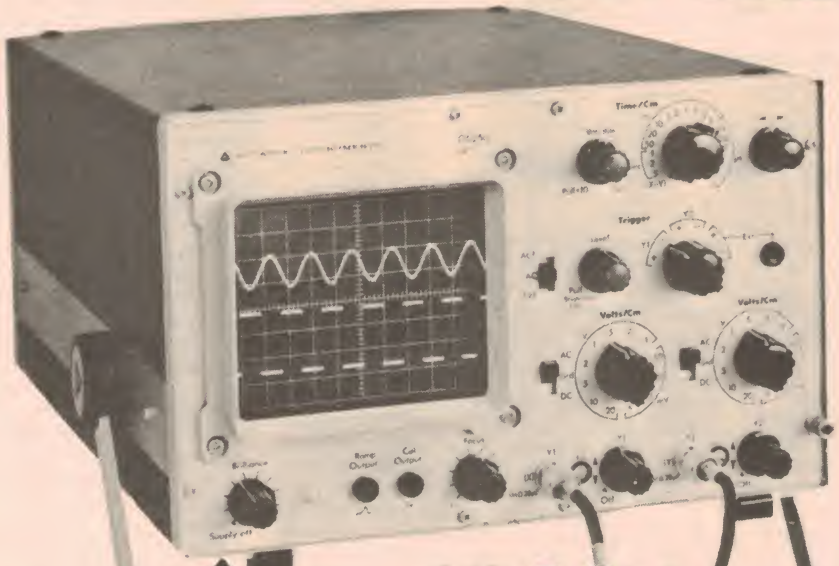

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CLASSICAL RECORDS

Nor is there anyone around at present to compete successfully with Fischer-Dieskau's impressive Papageno. There has been a tendency in recent years to chide this singer on the grounds of his over-attention to phrasing. He is accused of developing it into a mannerism. But in this role such pointing of phrases is an absolute necessity and Fischer-Dieskau brings it all off without apparent effort. Moreover it is delivered by a voice that, in those days, remained as freshly beautiful as it was when first heard. And if I add that there is not a hint of clumsiness in a single bar of the difficult part you might get a good idea of the magnitude of the achievement.

As Sarastro, Crass' voice lacks the natural beauty of either of the other men I have mentioned but he still makes an impressive priest, dignified, smooth in phrase and with a sense of Mozartian style that never deserts him.

The Queen of the Night is one of the most difficult coloratura roles in all opera and here Roberta Peters is fine, her decoration delivered with the utmost clarity but with, alas, an occasional tendency to shrillness on very high notes. I can't think of anyone in recent years who sang the role better than Rita Streich but her voice, in a big hall, always sounded much smaller than it does on records and the reverse is true of Miss Peters. Evelyn Lear (Pamina) shows traces of nervousness at times and is now and again a trifle wayward in pitch but I think Bohm's slow tempos in her music might well be an important contributing feature to these slight deficiencies.

But her natural beauty of tone does much to atone for other minor blemishes.

The Three Ladies are less successful. They lack vocal allure and seem to have little idea of how to produce elasticity of rhythm. Moreover Hildegard Hillebrecht sometimes develops a wobble all too reminiscent of that which mars the singing of all but very few Eastern European sopranos. But, as I wrote above, who has ever heard a perfect performance of this always fascinating opera? But if the Australian Opera's production tempts you to look for a recording that, to my mind is the best around, I can recommend this one with the greatest enthusiasm.

★ ★ ★

BARENBOIM IN PARIS — Three orchestral suites by Bizet. Carmen Suite. Jeux d'Enfants. L'Arlesienne No 1. Paris Orchestra conducted by Daniel Barenboim. EMI Stereo OASD 2915.

The Carmen Suite starts unexpectedly not at the beginning of the Prelude to the opera but with the Death Motif. And very ominous Barenboim makes it sound — melodramatically so. The music then goes on to the second, third and fourth act preludes — or entractes, if you like. In the first of these the tempo drags and the flute solo is abominably over-phrased. It is all so utterly uncharacteristic that I passed over the rest of the Carmen bits and went on to Jeux d'Enfants, one of my Bizet favourites. This starts better with the march, though even here Barenboim again shows a tendency to play it too ponderously. It could hardly be called idiomatic even though played by a French orchestra. I don't know what they thought of this kind of reading during rehearsal but I can guess. The second item, the berceuse, suffers also from a lethargic tempo but the third, the Impromptu, is much more brightly and delicately handled. The engineering is always bright, sometimes even a trifle brash. After having played the ultra-serious prelude to the First L'Arlesienne Suite I lost interest in the whole exercise and decided not to plague myself with any more. In view of Barenboim's other splendid achievements, this disc, hopelessly un-French, will add nothing to his reputation.

★ ★ ★

KHACHATURIAN — Piano Concerto in D Flat.

FRANCK — Symphonic Variations for Piano and Orchestra. Alicia de Larrocha with the London Philharmonic Orchestra conducted by Rafael Fruhbeck de Burgos. Decca Stereo SXL6559.

This disc offers a strange mixture. Soloist and conductor seem content to let the first movement of the Khachaturian go along quite without any devil. I admit that care must always be taken not to make it sound brash, which can easily happen. On the other hand it loses all its character when treated as limply as it is here. And this despite first rate engineering from Decca and an excellent balance between soloist and orchestra. Things improve during the big climax of the movement though I feel this is due to the urging of Fruhbeck who seems suddenly aware of what has been going on. But when the pianist has a long solo passage things once again lapse into something very close to apathy. This makes what happens in the following slow movement all the more amazing because, to my mind, it is the most poetic performance I have ever heard. Is it the memory that pianist and conductor are both Spanish that brings to mind Falla at his most romantic? There is only one jarring note in the movement — the prominence of the fluttering, whistling flexatone intended by the composer to supply an imitation of Armenian folk instrument but which only advertises the presence of an alien intruder into this lovely Spanish garden. Every other aspect of the performance of this movement is beyond praise as is the Finale, wonderfully stable despite its high speed. It also has the right touch of larrikinism in its swagger.

The Symphonic Variations follow and I don't think many readers will need to be warned to allow a decent interval after the Khachaturian before embarking on the Franck. Larrocha opens her contribution a little damply. Much of the middle and early sections sound not only too slow, but too deliberate also. Yet Larrocha's touch is never less than elegant and there are ravishing minutes especially when the tempo increases towards the climax of the 3/4 section, and in the quieter bars that lead into the grave contributions of the cellos just before the start of the brisk Finale.

Even here Larrocha sometimes gives the impression that she is holding back the tempo, though later her motives for this are made clear by the balance of the movement. Then comes the brilliant home stretch dash for piano and orchestra though elegance is never sacrificed to display. Fruhbeck leads his orchestra conscientiously throughout though I have, at other times, heard him sound much more committed.

Rachmaninov: Engineering "really startling"

RACHMANINOV — Symphony No 1 in D Minor. Orchestra of the Swiss Romande conducted by Walter Weller. Decca Stereo SXL 6583.

Those who till recently have thought it modish to disparage the music of that great composer, Tchaikovsky, have for years used the same treatment for that of his compatriot Rachmaninov. As this symphony, written when Rachmaninov was only 22, will attest, he was not a figure to be ignored even in his very early years. And this despite the farcial reception the work received at its first airing, which disgusted the composer so much that he destroyed the score. However he happily overlooked the band parts which, of course, made the compilation later of another full score a comparatively easy job for any competent musician.

The first feature to strike one — and I mean just that — in this issue is the engineering, really startling in its impact in the very first bar. Later the sound produces subtleties in such abundance that I am tempted to put it up among the very finest recording feats of modern times. The symphony's Russian origin is patent all through, with particular allegiances paid to Tchaikovsky and Borodin. Unless warned, the average listener would not guess that much use is made of chants of the Russian Orthodox Church.

The symphony should offer no difficulties to anyone used to listening to symphonic music, and perhaps even to many who aren't. It is consistently melodious, its themal development is nowadays easy to follow, and the relationships between the four movements at once apparent. The fine playing of the Swiss Romande Orchestra is enhanced by the recording quality. The string section seems to have improved quite wonderfully of late having gained much in weight and tonal richness. And the same might well be said about the other departments of the band. If you want a sample of the technical skill of the 1973 Swiss Romande try the dauntingly difficult second movement, the fugato in the first, and the brass at the beginning of the Finale. Under the influence of conductor Walter Weller some treats might well be expected from this orchestra in the near future.

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Recording connector: Output level −29.5 dB
Output impedance 80k ohms
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Reviews of other recordings

Devotional Records

CONCERT FOR PEACE. Mass In Time Of War, Haydn. Leonard Bernstein, Orchestra, The Norman Scribner Choir, Patricia Wells, Gwendolyn Killebrew, Alan Titus, Michael Devlin. Stereo, CBA, SBR-235603.

On January 19, 1973, something like 15,000 people crowded the Washington National Cathedral and its environs to share in Leonard Bernstein's concert for peace in Vietnam. This recording of Haydn's Missa in Tempore Belli, which provided the musical substance of the concert, was recorded in the Cathedral the following day.

Side 1 had "Kyrie" and "Gloria", while side 2 has "Credo", "Sanctus", "Benedictus" and "Agnus Dei". The background to the concert and the work, along with the well-known text in Latin and English is given in the detailed notes on the jacket.

While some may react to the recording as a concert work, my present evaluation was based on the devotional aspect, with at least as much emphasis on the text as the music. On this basis I enjoyed it as an extension to the more usual content of the devotional section. If you are at all partial to this kind of music, you'll probably react the same way.

Technically, the sound is clean, although the acoustic environment has tended somewhat to reinforce the middle register. But don't let that put you off. (W.N.W.)

★ ★ ★

THE BILLY GRAHAM International Crusade Choirs. Stereo, RCA Camden ACL1-0038.

Digging back through my collection, I located the original release, a mono "Souvenir Album" RCA L-10929. This Camden budget priced re-release has been re-mastered in stereo and given a completely new jacket. It certainly lives up to the title in its 17 tracks: Blessed Assurance (Charlotte, USA) — The Lord Is My Shepherd (All Scotland) — Ninety And Nine (Louisville) — Love Divine (London) — Marvellous And Wonderful (San Francisco) —Jesus Is Coming (Frankfurt) — Praise To The Lord (San Francisco)—I'm Glad I'm Singing (Gothenburg) — Pearly Gates (Charlotte) — How Great Thou Art (New York) — All That Thrills (Melbourne) — Mighty To Save (San Francisco) — Verily, Verily (Charlotte) — To God Be The Glory (London) — Every Time I Feel The Spirit (Charlotte) — Song Of The Soul Set Free (Sydney) — When I Survey (Charlotte).

Having in mind the age of these "live" recordings, it is not surprising that they benefit from a touch of treble cut to round out the massed soprano voices but, if you want to revive memories of 1959, you won't quibble about this, particularly at the Camden price. Incidentally, Bev Shea of the same era features in several of the tracks. (W.N.W.)

★ ★ ★

THOMAS EDMONDS Sings Songs Of Faith. Volume 2. Stereo, RCA Camden VCL1-0002.

Following successes in Europe, Thomas Edmonds returned to Adelaide to make this album with organist Barry Hall and the Loreto Convent Girls' Choir under Colin Curtis. As the title indicates, this is a sequel to the first successful album, reviewed in these columns some time ago.

Thomas Edmonds' voice ranging from baritone to tenor, is smooth and under tight control, with excellent diction. He has good rapport with Barry Hall although, to my ear, the electronic organ could have contributed a little more weight in the lower register. But I quibble.

The songs are all well known: How Great Thou Art — Nearer My God To Thee — The Day Thou Gavest — What A Friend — Tell Me The Old, Old Story — Amazing Grace — I Need Thee Every Hour — The Stranger Of Galilee — There Is A Green Hill — The Glory Song.

At the Camden price, this is good value if you don't already have too many similar collections. (W.N.W.)

★ ★ ★

NEARER MY GOD TO THEE. Pat Boone. Dot (Festival) L-31489.

This is a really old one, which I originally reviewed in 1962 as a mono release on the London label. It has not been re-released on "Dot", probably because the early "straight" style and good diction of Pat Boone still finds good support from those who like their sacred songs that way. I quote from the original review, for the guidance of those who may be attracted:

Pat Boone certainly provides variety on this disc. It begins with a modern "He", Understand" and finishes with "The Lord's Prayer"; it puts Shubert's "Ave Maria" between "I Believe" and "He"; "Steal Away," complete with narration, and a rhythmically developed "Closer Walk" rubs shoulders with "Nearer My God To Thee" and "The Old Rugged Cross."

But, as I implied it's extremely well done — and extremely well recorded, with an incisive solo voice maintained against a kaleidoscopically changing pattern of vocal, instrumental and reverberated, sound. Nor should I omit mention of the kind of bass which warms the heart of amplifier enthusiasts. (W.N.W.).

Instrumental, Vocal and Humour

CONCERTO NO. 2 for guitar and orchestra by Rod McKuen. Juan Marias, guitar, with the Symphonie de Madrid, conductor Arthur Greenslade. Also Five Pieces for Orchestra by Rod McKuen. McKuen, with the London Arte Orchestra conductor Arthur Greenslade. Stereo, His Master's Voice OCSD 7703.

Frankly, I find myself nonplussed by this disc. I know McKuen to be an intelligent and sensitive composer, but I was unable to discern any real feeling for concerto form in his work for guitar and orchestra. Equally I could find little of interest in his short orchestral items on side two. While I am quite prepared to be proved wrong, I have the feeling that McKuen's essays into the more serious realms of music are likely to have little success. One you should try to hear for yourself, if you are an admirer of McKuen's work. The sound quality is of good modern standard. (H.A.T.)

★ ★ ★

THE POCKET BACH. George Fields, harmonica. Stereo, His Master's Voice OCSD 7707.

"Inventions, Sinfonias, Fugues, Bourrees, Gavottes and other works transcribed and performed in unique multi-track recordings . . . (on) four octave chromatic and bass harmonicas." Thus this recording is summed up on the sleeve. Any questions?

The one which comes to my mind is "How many Bach lovers will take to hearing his music performed on the harmonica or, alternatively, how many harmonica enthusiasts are also Bach lovers?" Frankly, I doubt whether there are many, but if you happen to be one, I am sure you will appreciate the undoubted skill Mr Fields brings to his task — one which must have posed him innumerable technical difficulties. If the idea interests you, best try to hear a few sample tracks before buying. (H.A.T.)

★ ★ ★

GILBERT AND SULLIVAN HIGHLIGHTS No. 2. Glyndebourne Festival Chorus and Soloists with the Pro Arte Orchestra, conducted by Sir Malcolm Sargent. Stereo, His Master's Voice SOELP 10049.

As in No. 1 disc, this second disc has popular numbers from "The Mikado," "The Gondoliers" and "HMS Pinafore" but here we also have excerpts from "The Pirates of Penzance."

Since the best numbers from the first three were included in the first disc, this second disc by itself would have little attraction (although it has "Three Little Maids from School," missing from the "Mikado" selection in disc 1. Somebody slipped up badly by duplicating "We Sail the

Reviews in this section are by Neville Williams (W.N.W), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Gil Wahlquist (G.W.), and Norman Marks (N.J.M.).

Ocean Blue" and "My Gallant Crew, Good Morning" in the "Pinafore" selections. There are five numbers from "The Pirates": O Better Far to Live and Die — Stay, We Must Not Lose Our Senses — I Am the Very Model — When You Have Left our Pirate Fold — Poor Wand'ring Ones.

The standard of performance in these well known recordings is high throughout, and although dating from the late 1950s, the sound is acceptably clean, although tending to somewhat restricted dynamic range. (H.A.T.)

★ ★ ★

SWAN LAKE — complete music of the ballet by Tchaikowsky. L'Orchestre de la Suisse Romande, conducted by Ernest Ansermet. Stereo, Ace of Diamonds SDDA 354/5. Two record set in folding sleeve.

Complete recordings of Tchaikowsky's "Swan Lake" are fairly rare, and this one in the budget price range may well be unique — I know of no other. If then you would like to hear more of this great score than is to be found in the well known suite — which occupies only one side of an LP disc — and do not feel inclined to spend the $12 plus for a full priced set, you may well be tempted by this set.

Dating from 1959, and thus a very early stereo recording, it cannot compare technically with modern recordings, but is acceptably clean for the most part, although the bass instruments sound somewhat muffled. The experienced Suisse Romande players play with their usual competence, and are particularly pleasing in the more tender passages. (H.A.T.)

★ ★ ★

FIESTA FOR DANCING. Roberto Delgado and his orchestra. Polydor stereo 2371 404.

Here is another highly enjoyable album from Roberto Delgado and his orchestra. Bright and tasteful arrangements complement the lively line-up of tunes. There's even a Moog synthesizer featured in some arrangements but its use is entirely complementary to the other instruments and not just a big gimmick.

Recording quality is generally good but the sound does deteriorate on one of the innermost tracks. Tape hiss and surface noise are non-existent. In short, a good buy.

The twelve tracks are as follows: Fiesta Mexicana — The Mosquito — Eres Tu — Un Canto A Galicia — Happy Mexican — Canta Libra — Ela-Ela — It Never Rains In Southern California — Yellow Boomerang — When The Sun Says Goodnight To The Mountain — Concierto de Aranjuez — Last Tango In Paris. (L.D.S.)

★ ★ ★

MANTOVANI'S MAGIC TOUCH. Stereo, Decca 2-record set DDS1.

Mantovani has been making sweet music for long enough to have earned several times over the implication in this title: "Magic Touch".

No less to the point, the numbers on the four sides lend themselves to the treatment and, if you like them, plus Mantovani, purchase will be almost automatic: Misty — Red Roses For A Blue Lady — Love Me With All Your Heart — Goodnight Sweetheart — Cara Mia — I Wish You Love — Love — Stardust — Mona Lisa — Most Beautiful Girl In The World — Auf Wiedersehn Sweetheart — On A Clear Day, You Can See Forever — Alfie — Release Me — A Man And A Woman — Almost There — What Now My Love — Edelweiss — A Day In The Life Of A Fool — My Cup Runneth Over — Days Of Wine And Roses — The Impossible Dream — Puppet On A String.

The strings are a trifle "edgy" here and there but the overall balance is okay and the surface is quiet. (W.N.W.)

Familiar Sound

EBB TIDE, and other Million Sellers. Frank Chacksfield and his orchestra. Stereo, Phase 4, Decca 2-record set BSP-23-½.

Whether or not you realised it, you will certainly have heard some of these tracks many times. On the four sides, Frank Chacksfield has assembled twenty firm favourites, giving them the "sweet music" treatment. This doesn't mean that he makes them uniformly lush and dull. Style, tempo and treatment vary with the number but the end result is always highly listenable.

Here are a few of the tracks: Ebb Tide — Up, Up And Away — Zorba's Dance — Mrs Robinson — Alfie — In The Still Of The Night — Bali H'ai — Come Together — Red Sails In The Sunset — James Bond Theme.

The quality is excellent and you can either turn up the wick or let it play along gently while you dine. A good set. (W.N.W.)

★ ★ ★

WALTZES FROM VIENNA. Robert Stolz and the Vienna Symphony Orchestra. Stereo, Columbia TWO-348.

Not by any means a new album on the lists but still a good seller for EMI, this "Studio 2" recording features six waltzes. Johann Strauss II: "The Blue Danube", "The Lagoon Waltz", "Tales From The Vienna Woods" and "Vienna Blood". Josef Strauss: "Music Of The Spheres" and "Village Swallows".

Under the aging Stolz the music is staid rather than gay but the apparent popularity of the album seems to indicate that a lot of people like it that way. Recorded in Vienna, the quality is adequate for enjoyment of the music but not otherwise notable. (W.N.W.)

★ ★ ★

THE 2nd CRUSADE. The Crusaders. Blue Thumb stereo L45375/6. 2-record set, $7.95. Manufactured and distributed in Australia by Festival.

The Crusaders might fairly be lumped under the heading "black jazz rock." They have a heavy driving sound somewhat akin to the sound put out by Booker T. and the MG's but I use this comparison only because the MG's are well known. Whether you can listen to the whole four sides at one sitting is doubtful but spread out over a period you'll find some great listening. Sound quality is good throughout.

There are thirteen tracks in all, some very long: Don't Let It Get You Down — Take It Or Leave It — Gotta Get It On — Where There's A Will There's A Way — Look Beyond The Hill — Journey From Within — Aint Goin' Change A Thing — A Message From The Inner City — A Search For Soul — No Place To Hide — Tomorrow Where Are You? — Tough Talk — Do You Remember When? (L.D.S.)

★ ★ ★

PAUL FURNISS AND THE ECLIPSE ALLEY FIVE. THE UNITY JAZZ BAND. Festival stereo L25064.

Both the Eclipse Alley Five and the Unity Jazz Band are local Sydney jazz bands playing in authentic New Orleans style. Tracks for the EA Five were put down in February 1973 and for the latter band on 10th March 1973. Both performances have a real spontaneity and drive and are a pleasure to listen to. If you have a party and the guests like New Orleans style jazz, it'll be a roaring success with this record and a couple of others like it.

Recording quality is very good — the record is a credit to Festival.

Tracks played by the Eclipse Alley Five are: Buddy's Habit — Night And Day — Michigander Blues — Saratoga Shoot —

Chuff Chuff . . .

IN DAYS OF OLD (When the fuel was coal and the engines ran on steam). Stereo, Locofonic LRS-002. (From Locofonic Recording Service, PO Box 124 Northbridge 2063. Price $5.50 incl. postage by certified mail.)

When reviewing the last steam loco recording, I registered some aloofness because the locos were all from SA, with type numbers less than familiar to a New South Welshman! I can have no such complaint about this album, because it features locos with type numbers unforgettable to an erstwhile daily steam train traveller like 3246, 5353, 3801. Of course, there are "modern" engines like the 59 "Mikados" and the 60 "Garretts," as well as some other assorted types like the 19, the 30 and a 35 "Nanny."

In fact, it's the older engines that produce the best recordings because their sound is more distinctive than that of the Garretts, and the tandem Garretts, with mighty puffs

coming from everywhere at once!

But there's some mighty good train sounds on this album, particularly on side 2 and, if you play it on a quadraphonic system, at night, at a good level, you'll have the neighbours peering quizzically towards the distant rail line.

Railway fans are loco? Well what about stamp collectors and bird watchers? (W.N.W.).

THE STANTON CARTRIDGE . . .
A Critique by the experts

HI-FI STEREO REVIEW The tracking was excellent and distinctly better in this respect than any other cartridge we have tested. The frequency response of the Stanton 681EE was the flattest of the cartridges tested, within ±1dB over most of the audio range.

AUDIO The 681's low-mass stylus assembly is probably responsible for the cartridge's superb tracking performance at such low forces as 1 gram. We found that the Stanton 681EE tracked some previously "unplayable" records . . . 681EE is not at all susceptible to hum pickup . . . The 681EE stands among the top few cartridges on the market.

STEREO & HI-FI TIMES "I have subjected the cartridge to a series of standard test records which I use for all cartridges I test. In all cases this Stanton is as good as any I have yet checked, better in some cases than all others, no worse in any case than any other. Stanton calls this cartridge a "calibration standard". My tests confirm these figures."

HIGH FIDELITY The cartridge's vertical angle was exactly 15 degrees—the first, incidentally, that CBS labs has ever measured that was exactly 15 degrees! This is a cartridge that can reveal acoustic differences among recordings, that accommodates itself to the musical demands of the recorded material, and that can track the most demanding of groove passages like a champion. We mark it, in fact, as one of the very best yet auditioned.

but YOUR Cartridge didn't get a good review!

Perhaps one like it did. Same make same model, but not the one in your turntable.

Pickup cartridges are notoriously variable in quality. Take a dozen Brand A Model X and you can get a dozen different sounds.

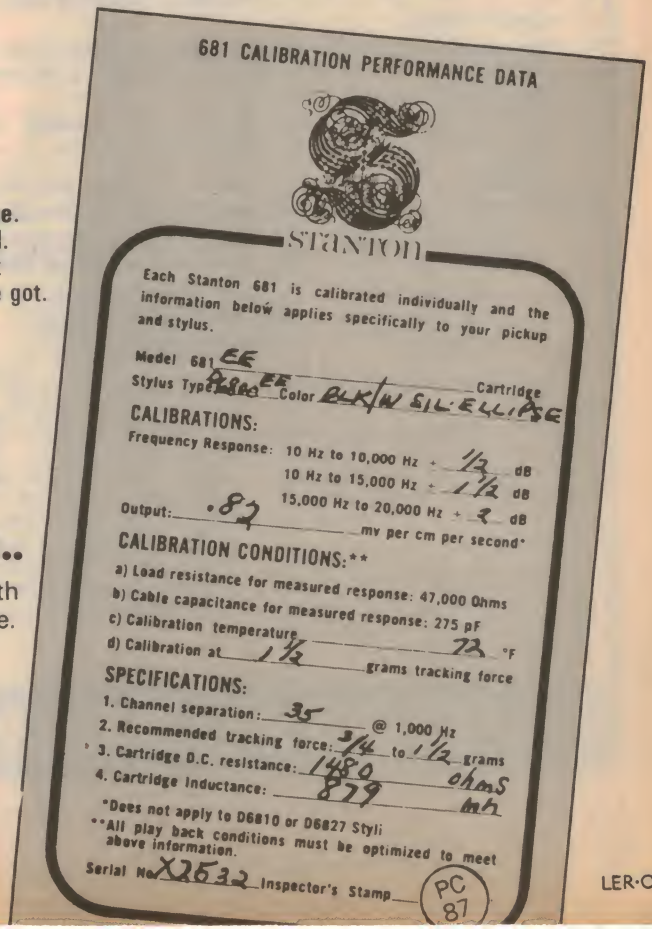
That's why the Pro's use Stanton 681EE, the **Calibration standard Cartridge**. **Every** 681EE, not just one in ten, or one per hundred, is individually measured. if its not up to specification (and what a specification!) it is rejected. It's not sold to you on the strength of a review that a hand-picked special might have got.

Rigid quality control is expensive. That's why the Stanton 681EE sells for $72.00. Expensive. Not a rip-off price, but expensive. Still you'll get more improvement for $72.00 by changing to Stanton 681EE than any other $72.00 you could spend on your gear.

So you know that the Stanton Cartridge you buy for your turntable is exactly the same in all significant parameters as the one that got rave reviews from "High Fidelity", "Audio", "Hi-Fi/Stereo Review", and other top authorities.

the proof of Stanton Superiority...

This unque calibration performance chart is supplied with **every** Stanton 681EE cartridge.



681 CALIBRATION PERFORMANCE DATA

STANTON

Each Stanton 681 is calibrated individually and the information below applies specifically to your pickup and stylus.

Model 681 EE

Stylus Type 681 EE Color BLK/W SIL ELLIPSE Cartridge

CALIBRATIONS:

Frequency Response: 10 Hz to 10,000 Hz ± 1/2 dB
10 Hz to 15,000 Hz ± 1 1/2 dB
15,000 Hz to 20,000 Hz ± 3 dB

Output: .87 my per cm per second*

CALIBRATION CONDITIONS:**

a) Load resistance for measured response: 47,000 Ohms
b) Cable capacitance for measured response: 275 pF
c) Calibration temperature 73 °F
d) Calibration at 1 1/2 grams tracking force

SPECIFICATIONS:

1. Channel separation: 35 @ 1,000 Hz
2. Recommended tracking force: 3/4 to 1 1/2 grams
3. Cartridge D.C. resistance: 1480 ohms
4. Cartridge Inductance: 879 mh

*Does not apply to D6810 or D6827 Styli
**All play back conditions must be optimized to meet above information.

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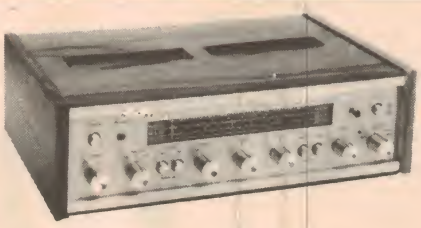

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★ ★ ★

MARI TRINI—AMORES Hispavox L34893 Stereo Festival release.

With the Waldo De Los Rios orchestra as backing, Mari Trini gives us eleven love songs in Spanish, in an intimate, almost whispering style. The record cover gives the lyrics of seven numbers in Spanish, together with the playing time of each track.

Some of the numbers are familiar to the ears, they include: Amores — Un Hombre Marcho — J'Attendrai — Vals de Otono — Cuando Me Acaricias — En Una Noche Callada — Manana. The quality is excellent. (N.J.M.)

★ ★ ★

"GOODBYE GEMINI" D.J.M. Record, Stereo SDJL934118. Festival release.

Most of the tracks on this sound-track recording have a great similarity to the music of "Hair" and other rock operas in style. Without having seen the film it is hard to appreciate the true context but as a technical demonstration disc to show the neighbours how high is your "fi" it would be ideal. There are thirteen mixed vocal and instrumental tracks including: Tell The World We're Not In — Jacki and Julian — Goodbye Gemini — Houseboat Party — Jacki's nightmare. The technical quality is superb, with an effective stereo spread. (N.J.M.)

★ ★ ★

FRANK CHACKSFIELD PLAYS BACHARACH. Decca Phase Four Stereo PFS-4230.

If your inclination or your wallet does not extend to a double album of Frank Chacksfield, this single LP might serve as a consolation prize. The arrangements by John Keating are varied, melodic and very easy on the ear and this goes also for those numbers which are perhaps less familiar than others: Raindrops Keep Falling On My Head — Alfie — I'll Never Fall In Love Again — This Guy's In Love with You — Paper — Close To You — You'll Never Get To Heaven — The Look Of Love — To Wait For Love — The Green Grass Starts To Grow — Wives And Lovers.

The quality is very smooth, the sound very clean. (W.N.W.)

★ ★ ★

GOLDEN HITS OF THE 60s. The Brass Ring. Probe stereo SPSS 10074.

I've not heard of the Brass Ring before but they sound like a very pleasant hybrid of Billy Vaughn's orchestra and perhaps Enoch Light. In other words, music that is very easy on the ear and just right for dancing cheek to cheek. Sound quality is good but the treble has a slight "edginess" about it at times. There is also some tape hiss but this is not troublesome. At the price of $2.99 it makes good buying.

Tracks are as follows: The Shadow Of Your Smile — Moon River — The Girl From Ipanema — Theme from "A Summer Place" — I Will Wait For You — Al Di La A Man And A Woman — Lara's Theme — Do You Know The Way To San Jose — Up, Up And Away — The Look Of Love — Georgy Girl. (L.D.S.)

★ ★ ★

BONFA, JACARANDA. Arranged and conducted by Eumir Deodata and Luiz Bonfa. Stereo, Interfusion (Festival) L-34966.

The jacket is trying to say something, both in its impressionistic design and in the words which the design renders almost unreadable. In fact, the words indicate that the musicians are trying to say something. And, in fact, they do. From the very first track, "Apache Talk", there's a primitive, back-to-nature feeling about it that get's to you, whether or not you are a devotee of progressive pop-jazz.

Yet the electric piano, electric bass, guitars, percussion, sax are far from primitive, while the musicians exhibit rare skills, both individually and collectively.

The track titles are: Apache Talk — Jacaranda — Gentle Rain — You Or Not To Be — Strange Message — Don Quixote — Song Thoughts — Danse V — Empty Room — Sun Flower.

The recording quality is excellent and it should sound pretty impressive — if you're allowed to play it at high level! (W.N.W.)

★ ★ ★

JIMMY SHAND PLAYS OLD TIME. Jimmy Shand And His Band. Stereo, Waverley (EMI) SZLP 2127.

Recorded two years ago, this old time dance album is still going strong. And, according to the jacket notes, old time dancing in the UK, at least, is more popular than it has been at any time since 1939.

Relying heavily on accordions the Jimmy Shand sound varies hardly at all from start to finish, but his technique of adapting Irish and Scottish airs provides an atmosphere all its own. (Ask my Scottish wife!) And, of course, the tempi are impeccable.

The twelve tracks provide for twelve dances: Festival Two Step — Corona Waltz — Bradford Progressive Barn Dance — Paradise Waltz — Balmoral Circle — Boston Two Step — Veleta — Highland Barn Dance — Princess Waltz — Military Two Step — Victory Waltz — London Scottish.

The quality is clean and the surface quiet. (W.N.W.)

★ ★ ★

COME LIVE WITH ME, ROY CLARK. Dot Stereo L34952. Festival release.

If country style ballads are your dish, give this disc a hearing. Roy Clark gives the Nashville treatment to eleven numbers including: I'll Paint You A Song — A Daisy A Day — Why Me — Daddy Don't You Walk So Fast — Come Live With Me — Soul Song — Nobody Wins — Soft Rain.

The mood is somewhat plaintive, the quality good. I have a relative who is a C&W fanatic so I know where this disc will end up! (N.J.M.)

★ ★ ★

MARIA OSTIZ. Hispavox L34891 Stereo Festival release.

Eleven folk-songs sung in Spanish make up this very pleasant-to-listen-to record. With guitar and group backing of high quality, Maria Ostiz takes us through: You Don't Know How I suffered — The Jugglers — Don't Tell Me Anything — The Princess — I'll Be Back Soon — Anonymous Romance — Each Place — Road From The Sea — For Your Freedom — Shepherdess — Run Down The Road. Her voice is a delight to listen to and is matched by the quality of the record. (N.J.M.)

★ ★ ★

GOLDEN HOUR OF MAX BYGRAVES. Something Old, Something New. Stereo, Astor GH-513.

The album in the Astor "Golden Hour" series carries no less than 24 tracks from vocalist Max Bygraves. As the jacket notes observe, one hour of the one artist could be a

FOR 4-CHANNEL ENTHUSIASTS

SUPERSONIC QUADRAPHONIC SOUND SPECTACULAR. Various Groups. Interfusion (Festival) LQ-34950.

You will search in vain for any statement on the label or jacket of this album as to the matrix system involved. Whatever it is, through a standard SQ decoder, it produces as convincing separation as you are likely to hear from a non-logic system. Mind you, it's the studio pan-pot variety, produced with separation as the objective.

Musically, it's all in the pop class which quietens down (thankfully) after the first track: One Fine Morning — Nice Things — Walking In Space — Gonna Make It This Time — Prelude In Ab Crazy — Can't Take My Eyes Off You — Songs For Singing — Sittin' On The Dock Of The Bay — Rachmaninoff Prelude.

The quality is very clean and it would be entirely suitable to have among your quadraphonic "show-off" discs for those who are more at home with "The Electric Hair" or the "Mike Quatro Jam Band" than the London Symphony Orchestra! (W.N.W.)

THE BRASS MENAGERIE 1973. Enoch Light and the Light Brigade. Quadraphonic, Project 3 (Festival) SPJL-934493.

Matrix quadraphonic but, again, which matrix? Well, I played it through a standard SQ decoder and things happened in various places; but only Enoch Light would know whether they were the ones intended! One thing that did startle in a couple of the numbers was a series of handclaps from the sides that really made the point.

Whereas the quadraphonic demonstration disc reviewed elsewhere featured mainly electronic instruments, the Enoch Light group are strong on brass and woodwinds, guitars and Latin-American percussion. But they do work in a Fender bass and a Moog.

As you would expect, the music is a typical Enoch Light offering, in which the tunes are just a starting point for the various arrangers: Mambo — Macarthur Park — I Feel The Earth Move — Season Of The Witch — Hot Pants — Theme From "Shaft" — Proud Mary — The Night They Drove Old Dixie Down — Boy Meets Horn — Sweet Julie — Explorations For Moog.

You can usually rely on Enoch Light for technically good recordings and this one is no exception. Incidentally, that last Moog track really sends signals wandering around the room. (W.N.W.)

bit much if it were not for the fact that Max Bygraves is able to present a very pleasant and varied program. And, of course, there's no law that says you have to play both sides in sequence!

Among the tracks are songs like: You're My Everything — I Want A Girl — Mame — Hello Dolly — Those Were The Days — One Of Those Songs — Show Me The Way To Go Home — Charlie Girl — Second Hand Rose, and many others.

Despite the tightly packed grooves, the quality is well up to standard and the surface is good. Well worth a second look! (W.N.W.)

Jazz and Rock . . .

SEXTANT. Herbie Hancock. Avan-Guard stereo SVL-328.

Herbie Hancock gives listing of instruments in their order of appearance which is just as well. He appears to have gone all-electric, playing Fender Rhodes electric piano, Hohner D-6 clavinet with Fender Fuzz-wah and Echoplex, dakha-dibello, melotron and, oh yes, a Steinway piano.

Hancock's jazz is just as revolutionary to today's listener as Jimmie Lunceford's was to jazz listeners in the 30s.

Hancock does not wish to be trite, to state the obvious. His "Rain Dance" is more than a token of worship. Electric devices give us a watery statement, but then a group of jazz musicians, using the most sophisticated of equipment, indulge in a mass improvisation which is as basic as that engaged in by those members of cultures who still worship the rain — without the benefit of an LP record. Julien Priester is on trombone, Dr Eddie Henderson on trumpet, Benny Maupin on reeds and Billy Hart on drums. Fantastic. (G.W.)

★ ★ ★

YOU'VE GOT IT BAD GIRL. Quincy Jones. A and M stereo AML 34935.

Although "Sanford and Son" is a revolting television show, it has a good theme tune, written by Quincy Jones and performed on this disc by harmonica player Tom Morgan.

There's a fair bit of jazz harmonica on the disc, mostly featuring "Toots" Thielmans.

There are others present. Cat Anderson hits the high notes behind Quincy's vocal on the Stevie Wonder tune "Superstition". Phil Woods plays alto on "First Time I Ever Saw Your Face". The thing about the Quincy Jones orchestra sound is its bigness and diversity. This is jazz which comes from a big city and doesn't compromise on its origins. (G.W.)

★ ★ ★

JACARANDA. Luiz Bonfa. Interfusion stereo L34966.

Brazilian guitarist and composer Luiz Bonfa, who many years ago spearheaded the Afro-Cuban music trend, still has a lot to teach us. He plays 12-string and 6-string acoustic guitars on this jam with a group of musicians that includes the percussionist Airto Moreyra and conga player Ray Barretto.

His 12-string guitar solo on the title track is quite without precedent as far as I can remember. Its feeling goes deeply into jazz. "Apache Talk," which precedes it, cuts the usual rock guitar break to ribbons.

The excitement on the record is intense. It rips away a lot of the commercialism which has watered down bossa nova jazz. (G.W.)

★ ★ ★

M.F. HORN 3. Maynard Ferguson. CBS stereo SBP 23411.

Ferguson plays two trumpets of his own design, an M.F. Horn and M.F. Superbone on this disc. The new instruments handle his exceptional blowing power better than the traditional trumpet, which tended to squeak uncomfortably in the upper registers.

"Awright, Awright," the swinger which opens the albums, displays both instruments and shows a warmer, fatter tone than others heard from Ferguson. It's the same for "Round Midnight," with a wonderfully soft open-horn solo. Ferguson has a 15-piece band which plays with feeling in the post-Kenton tradition. (G.W.)

★ ★ ★

BEIN' GREEN. Urbie Green. Project 3 Quadraphonic PJL34812.

It's such a change to get a jazz record in quad. Urbie Green, a polished and inspired trombonist, constructs his own trombone choir by multi-tracking on a number of performances.

I love the way the trombones join in like bells on "Brand New Key." His "Quadrabones," written by Dick Hyman, is all trombones, just the four brass with no other accompaniment.

"The Weenies" is an all-in jam. The pianist and bassist are not named. They are tasteful and inspired. Urbie's trombone is a King 2B. He even plays "Ave Maria" on it. (G.W.)

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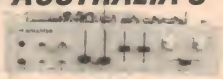

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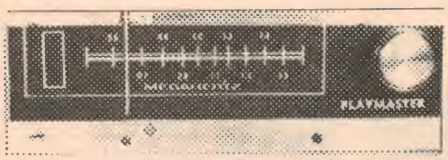

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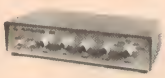

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Product reviews & releases

Teac A-160 Stereo Cassette Deck

Teac make a whole line of open-reel and cassette tape decks, which enjoy a high reputation in the hifi marketplace. Here we review the new A-160 model, one of their less costly stereo cassette decks featuring Dolby noise reduction.

By comparison with other cassette decks, the Teac A-160 is certainly less flashy — some would even say spartan in appearance. The main deck control panel is finished in low-gloss scratch grain aluminium, while all the controls are black or coloured plastic instead of the more usual metal sheathed plastic.

Dimensions are 420 x 258 x 120 mm (W x H x D) and the weight is 5.7 kg.

Five piano levers and the pause push-button control the tape transport mechanism. One small hassle we found with these controls is that you cannot flip the cassette well cover open with the STOP / EJECT control without ejecting the cassette at the same time. Perhaps this would not be necessary if the smoke-tinted cover was a little more transparent. The A-160 is not alone in this respect — on most machines it is not easy to tell how far the cassette has progressed without flipping the cover open.

The Teac A-160 stereo cassette deck has Dolby noise reduction and provision for chromium dioxide tape.

The transport is powered by a single DC motor which is electronically speed regulated. An interesting feature of the transport is that a system of gears and idler pulleys drive the tape spools during fast forward and reverse, to give more positive tension on the tape.

Four slider controls are provided on the control panel. Two control the recording level from the microphone or line inputs while the other two control the playback recording level. This latter feature is very handy when listening to the deck via the stereo headphone jack.

Five toggle switches are provided for power, Dolby, input selection (microphones or line input), bias and equalisation. While these switches have a very positive action, we would have preferred them a little smoother and lighter because they tend to jar the fingers. The piano levers for the transport controls are positive without being too heavy to operate.

In addition to the revolution counter, indication that the tape is actually running is provided by the flashing "tape run" indicator. This consists of a light which rapidly transverses seven little plastic windows to give the impression of transverse motion. In some ways this feature is a necessity because there is no automatic cut-out when the cassette has come to the end of its tape.

Inside, the Teac A-160 is certainly a lot less crowded than many other decks which have features such as recording limiters, end-of-tape cut-out and even solenoid control. The reduced clutter and complexity make access for servicing much easier.

Calibrations of the recording level were quite accurate and the response of the metering circuitry was also reasonably wide. A feature we missed on this deck was an overload warning indicator lamp which flashes when sudden peak overloads occur — such overloads are not registered by meters.

Wow and flutter is specified at 0.15 pc. In practice, this figure would appear to be achieved but is difficult to verify because it can depend to a large extent on the particular cassette used. Some cassettes will allow much lower wow figures to be achieved than others.

As is usual for most cassette decks, the specifications for frequency response are extremely vague. With conventional tape it is quoted at 30 to 13kHz while for Chromium Dioxide tape it is quoted at 30 to 16kHz. No tolerance limits and no signal level are specified. In this situation, we perform a standard requency response test at a signal level of minus 20dB below maximum recording level, ie, 0dB or 0VU.

We used a high quality low noise virgin cassette for all tests. For conventional tape, the frequency response checked out at plus and minus 2dB from 30Hz to 10kHz with very rapid rolloff beyond that point. With chromium dioxide tape, the response is very little better but that probably indicates that the ferric oxide tape we used was of particularly good quality. This situation will become more common, so that the advantage of using CrO2 tapes will tend to diminish.

We found that the Dolby noise reduction circuitry actually degraded the response to the tune of plus 4dB and minus 3dB from 30Hz to 10kHz. But at the same time, the Dolby noise reduction does make a decided reduction in the apparent hiss level. It does not improve the unweighted signal-to-noise ratio, which was minus 44dB with respect to 0dB recording level. This is quite a respectable figure for most cassette recorders.

Harmonic distortion at 0dB was quite low at around 1.5pc at 1kHz and even when the signal level was increased 3dB above that distortion was still less than 2 pc. This is very commendable and is quite a lot lower than we have measured on more expensive machines. It indicates that Teach have been conservative in establishing the signal levels within the machine, and gives a margin of error when recording which effectively increases the available dynamic range.

Separation between channels was also commendably high, ranging from minus 42dB at 1kHz down to around 30dB at 10kHz. This is again better than many other machines achieve.

In use, the Teac A-160 sounds not a great deal different from most other cassette recorders in the market which feature Dolby noise reduction. In practice, it would seem that the degree of mechanical refinement and operating features determine the final price rather than the attained level of performance. The only niggle we had as far as the reproduction was concerned was that it seemed a little more susceptible to radar interference than most other decks we have tested. Still, this is not really a common problem. Most people are not in a direct line of sight with Kingsford-Smith radar!

Summing up, the Teac A-160 is a lower priced Dolbyised stereo cassette deck, well worthy of consideration by the buyer who cannot afford the more expensive machines. In buying it, there is a sacrifice in operating convenience over the more expensive machines but little reduction in audible performance. Recommended retail price is $275 including sales tax.

Further information on the A-160 can be obtained from hifi retailers or from the Australian distributors for Teac, Australian Musical Industries Pty Ltd, 619 Pacific Highway, St Leonards, NSW. (L.D.S.)

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NEW PRODUCTS

Philips PM5509 Colour Pattern Generator

Philips have just released the PM 5509 PAL television pattern generator, for use in servicing black and white and colour television receivers and equipment such as video recorders.

While Philips have promoted the PM5509 as a service and workshop instrument, it has far more comprehensive facilities than the relatively simple service colour pattern generators we have seen to date. And its physical presentation indicates it was designed more as a laboratory instrument.

Dimensions of the instrument are 210 x 180 x 250mm (W x H x D) while the weight is 3.7kg. The front panel is grey enamel with black push-buttons. The chassis framework is fabricated from aluminium extrusions while the exterior panels are of vinyl-covered aluminium.

Ten basic patterns are provided, five black and white and five colour. The first pattern is a black and white checkerboard of six by eight squares. This can be used for focus adjustment, linearity, aspect ratio, circuit ringing and mains hum interference with synchronisation.

The second pattern is a white circle on a black background. To our knowledge this generator is the first instrument of this size and complexity to include a circle pattern. The circuitry needed to generate a circle pattern represents a significant breakthrough. Hitherto, circular patterns have generally had to be produced by a camera aimed at a test card, and since each camera has its own characteristic non-linearity, the circle produced is never perfect.

This explains why a television receiver set up for picture linearity on the test pattern from one particular TV station does not give as good a result on test patterns from other TV stations. In practice linearity adjustments have had to be a compromise between several different broadcast test patterns. The circle available from the Philips PM5509, being electronically generated, does away with the need to use broadcast test patterns for linearity adjustments.

Standard dot and crosshatch patterns are available for static and dynamic convergence adjustments on colour receivers. In addition, the circle pattern referred to earlier can be superimposed on the crosshatch pattern (or any other of the patterns, for that matter) to give a composite pattern for a variety of adjustments. In fact, the

PM5509 could be the source of standard test patterns for receiver adjustment on production lines.

The remaining black and white pattern is a standard eight-step grey scale from black to white, combined with eight sets of definition lines for checking the video or luminance bandwidth from 0.5MHz to5MHz. The standard grey scale allows checking of the brightness and contrast circuits, and grey scale tracking in the case of studio monitors.

The grey scale is a linear staircase signal. It has not been derived from the colour bar signal by removing the chroma information.

A red raster is available with 50 per cent saturation for checking colour purity. A 100 per cent white pattern allows a number of checks such as purity, constant brightness and picture tube beam current.

The colour bar pattern is the 75 pc contrast, 100 pc saturation type, with eight bars in the standard sequence: white, yellow, cyan, green, magenta, red, blue, black. The lower one-third of the pattern is white to serve as a reference to enable adjusting the amplitude of the colour difference signals with respect to the luminance signal on the picture tube.

A special colour pattern is provided for checking the PAL delay line and circuitry. An additional pattern is provided for checking equipment such as video cassette recorders. It consists of what looks like a "Grey scale" in red (eight steps of increasing saturation), combined with a set of colour definition lines from 100KHz to 1MHz.

The RF carrier of the generator can be set anywhere within three bands ranging from 30 to 85MHz, 173 to 225MHz and 470 to 860MHz. Five push-buttons allow selection of preset carrier frequencies which are set by individual preset potentiometers on the front panel, to control varicap circuitry. The frequency and band are clearly identified with the aid of two illuminated edge-reading meters.

RF output amplitude is continuously variable by an attenuator with a range of more than 60dB. Maximum RF output is more than 10mV. Impedance is 75 ohms. Video modulation is negative AM but can be made positive with small change to a solder joint on one of the printed boards of the unit. Chroma is also continuously variable by an attenuator on the front panel.

RF, video and triggering signal for an oscilloscope are all available from BNC

(Continued on page 95)

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NEW PRODUCTS

Kikusui 536A CRO

For people with the need for a compact simple oscilloscope with reasonable performance, Jacoby, Mitchell & Co Pty Ltd have the Kikusui 536A. It has a bandwidth of DC to 1.5MHz and a maximum sensitivity of 20mV / cm.

There must be many hobbyists and technicians who have a use for an oscilloscope without frills but having a good basic performance. For such people the Kikusui 536A may well fit the bill. Dimensions are 140 x 205 x 360mm (W x H x D).

Unfortunately, we did not have an owner's manual at the time of writing so we cannot quote specifications at length or comment in detail on the circuitry. Bandwidth if the vertical amplifier is DC to 1.5MHz (3dB point) and AC or DC coupling can be selected. Maximum sensitivity of the vertical amplifier is 20mV / cm, which is relatively high for a CRO of modest performance.

Input signal attenuation is provided by a 3-position switch which gives 20dB steps, with an additional vernier attenuator concentric with the switch. Also provided by the input attenuator switch are reference voltage waveforms with peak-peak values of 0.5V and 50mV. Input impedance for the vertical amplifier is 1 megohm.

Horizontal timebase frequencies are from 10Hz to 100kHz in five steps of the timebase switch. In addition, there is a variable timebase control and further variation is possible via the horizontal gain control.

Synchronisation of the horizontal timebase is controlled by two slide switches. One selects the mode: Line, internal or external The other selects either positive or negative excursion of the waveform for timebase syncing.

Three printed boards are used to accommodate the bulk of the circuitry. One is used for the vertical stages, one for the horizontal stages and a small one for the EHT supply. The circuitry is solid state except for the vertical and horizontal output stages, which are provided by 6AQ8 twin-triodes.

One could say that this hybrid design is a conservative approach which gets the best of both worlds — plenty of gain at low noise for the small signal stages and a linear timebase, together with the ruggedness of valves for the high voltage output stages driving the tube deflection plates.

In use we found the oscilloscope easy to drive and all the controls have a very smooth, satisfying feel (this is what impresses audio fanatics). The markings on

the timebase control could have been less confusing though — we found them ambiguous. The trace is bright, sharp and free of hum and the timebase is very linear when compared with economy valve oscilloscopes of a few years back.

Recommended price of the Kikusui 536A oscilloscope is $158 plus 15pc sales tax where applicable. Further information can be obtained from Jacoby, Mitchell Pty Ltd, 215 North Rocks Road, North Rocks, NSW. (L.D.S.)

NEW PRODUCTS

New Ferguson Transformers

Ferguson Transformers Pty Ltd have released in a new range of low height transformers with a nominal rating of 40VA.

The new transformers use the same laminations and mounting hardware as the standard type of 40W fluorescent light ballast. They also comply with the requirements of Australian Standard C126, with respect to insulation and winding construction. Dimensions are: height limited to 380mm, width 60mm, length 110mm and mounting centres 18 x 98mm.

Each transformer is fitted with round pin terminals and is supplied with a set of six leads and a link with shrouded connectors.

Three of the transformers are general secondary windings with taps on each. This enables a variety of output voltages to be obtained from each transformer, using

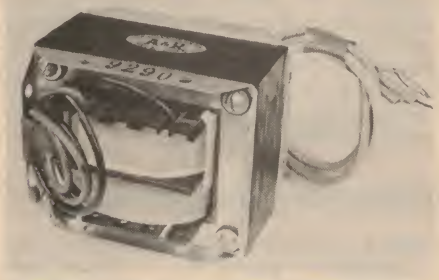
series or parallel operation. Power rating is a maximum of 40VA for continuous operation and this may be raised to 50VA for intermittent operation. Type numbers for the general purposes types are PL15 / 40VA, PL30 / 40VA and PL50 / 40VA. The number following the "PL" refers to the total secondary voltage at rated output current.

A special purpose transformer, type PL30-9 / 40VA is designed for use with integrated circuit regulators and other semiconductor components. It has two 15V secondary windings each rated at 7.5VA and a 9V winding rated at 27VA (3 amps). As before, these windings can be interconnected to give a variety of put voltages.

Suggested retail price for the transformers, including sales tax, is $7.95 and they will be available from suppliers throughout Australia. Further information is obtainable from Ferguson Transformers Pty Ltd, 331 High Street, Chatswood, NSW.

Playmaster 140 Power Transformer from A & R

A & R Transformers Pty Ltd have released a power transformer, type 9290, specifically designed for the Playmaster 140 4-channel amplifier featured recently in



"Electronics Australia." It will fit into the space provided on the chassis but has different mounting centres to the transformer originally specified.

Philips Pattern Generator

connectors on the front panel. External video may be applied to the RF carrier via the same BNC connector as for video output, by pushing the EXT video button.

Sound carrier frequency is standard at 5.5MHz but can be changed internally to a choice of 4.5, 6 or 6.5MHz. Modulation is FM at 1kHz but can be changed to AM. External audio modulation can also be applied via a DIN socket on the rear panel. Since both external video and external audio can be applied the PM5509 can form the basis of a modulator for experimental work.

The comprehensive manual not only gives good colour reproduction of the patterns but shows typical PAL faults and also colour difference signals. In addition, it shows typical oscilloscope waveforms for the colour difference signals. PAL delay line and demodulator oscilloscope waveforms are also shown.

In use, the PM5509 is straightforward to drive and gives easy familiarity. Patterns are precise and noise free, and the ability to superimpose patterns is a handy feature. The presettable RF carriers also allow selection of a suitable frequency away from local television broadcasts, so that no interference effects are produced on the screen.

Overall, the PM5509 is a comprehensive instrument which will find much application in laboratories, studios, and in the larger service organisations. Considering the number of facilities it provides, it is very reasonably priced at $595 plus sales tax where applicable.

Further information on the Philips PM5509 PAL pattern generator can be obtained from Philips Test and Measuring Instruments, 200 Goulburn Street, Sydney. (L.D.S.).

Books & Literature

Amateur Radio

HAM NOTEBOOK, edited by James R. Fisk, WIDTY. Published by Communications Technology, Inc. Greenville, New Hampshire, 1973. Soft covers, 151 x 228mm, 176, many circuits, diagrams and pictures. Price in USA $3.95.

A collection of the handy circuit ideas and other useful items which have been published over recent years in the "Ham Notebook" column of the US amateur radio publication Ham Radio Magazine. There are hundreds of circuit kinks and ideas, all basically practical and of the down-to-earth variety which amateurs generally find most useful.

The material is divided for convenience into ten sections, with the headings Antennas and Transmission Lines; FM and Repeaters; Keying and Control; Measurements and Test Equipment; Oscillators; Power Supplies; Receivers and Converters; Transmitters; VHF and UHF; and Station and Workshop. There is a topic index at the rear to help in finding wanted items quickly.

As is often the case with such collections, the material is a little variable in quality, but generally very up-to-date. More so than many textbooks and manuals, in fact. This together with its essentially practical outlook should make the book valuable to almost any amateur, whether working on HF or the higher bands. It certainly represents excellent value for money.

Two review copies were received, one from Technical Book and Magazine Company of 289 299 Swanston Street, Melbourne, and the other from Dick Smith (Wholesale) Pty Ltd at 162 Pacific Highway, Gore Hill, NSW. Both firms have the book in stock, the former at $3.95 plus 65 cents postage and the latter at $4.50 plus 30 cents postage. (J.R.).

Listening handbooks

HOW TO LISTEN TO THE WORLD, 8th EDITION. Edited by J. Frost and published by the World Radio Handbook Limited, Denmark.

This well established handbook for the radio listener covers various aspects of short-wave listening and the DX hobby. The 8th edition, which comprises 168 pages, has moved away from its usual format of having guest writers from various parts of the world, writing on specialised subjects. Much of the new edition takes a look at broadcasting through the eyes of the BBC.

Included in the pages are articles on the BBC relay station on Ascension Island, around-the-clock broadcasting, operating of the BBC monitoring service, a look behind BBC News and other allied subjects.

There are plenty of interesting items outside this field, including an international buyers guide for receivers, recorders, etc, articles on listening to Latin America, Africa, &c. Additionally, the reader is given detailed explanation on many aspects of short-wave propogation.

The book is available at technical book stores in Australia or from Arthur Cushen, 212 Earn Street, Invercargill, New Zealand. (A.T.C.)

WORLD RADIO & TV HANDBOOK — 1974. 28th Edition, published in Denmark by the World Radio & TV Co Ltd, edited by J. Frost.

The new edition contains 408 pages with details of virtually every broadcasting and television station in the world. It is noteworthy for new and rearranged information on Great Britain, Spain, USSR, Indonesia, Philippines, Papua New Guinea, as well as many Latin American countries.

The Editor explains that the aim of the World Radio & Television Handbook "is to give anyone with a working interest in the field of world radio and/or television an easy-to-handle book."

The World Radio Handbook is available at technical book stores in Australia or from Arthur Cushen, 212 Earn Street, Invercargill, New Zealand. (A.T.C.)

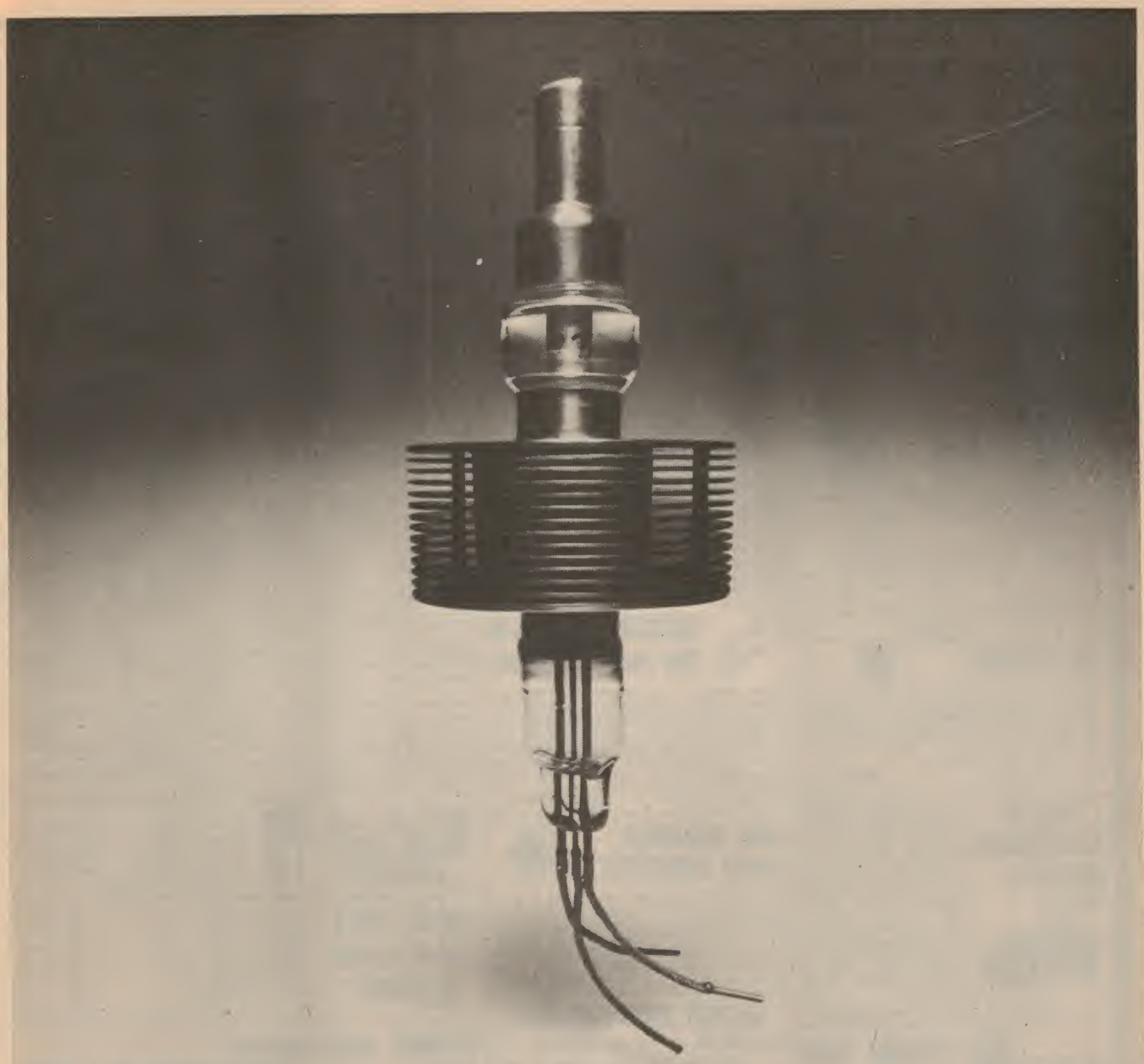
Aerial monograph

HANDBOOK OF CONICAL ANTENNAS AND SCATTERERS, by R. M. Bevensee. Published by Gordon and Breach science Publishers, New York, 1973. Hard covers, 235 x 160 mm, 173pp, many diagrams. Price in UK £10.20.

A rather specialised monograph, intended mainly for the antenna design specialist. It is based largely on computer analysis of various conical antennas and scatterers, conducted by the author at the Lawrence Livermore Laboratory in Livermore, California.

Presented in the book are newly computed theoretical characteristics of various

(Continued on page 107)



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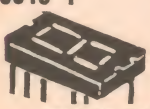

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Amateur band news & notes

by Pierce Healy, VK2APQ

New UHF Australian Record

Three Sydney amateurs created a new Australian record for the 5650MHz — 5850MHz band during the national field day held early in February 1974. This was achieved despite less than optimum operating conditions.

During UHF experiments held on the "John Moyle Memorial National Field Day" on Sunday 10th February, 1974, three Sydney amateurs Des Clift, VK2AHC; Dave Ralph, VK2SB and Norm Champion, VK2ZND, created an Australian record for a two-way contact on the 5650MHz — 5850MHz band.

The contact was made by Des VK2AHC operating portable at Kurrajong Heights and another portable station, located at Belrose, operated by Dave VK2SB and Norm VK2ZND. The distance was 59Km.

Due to poor weather conditions, Des was forced to operate his station from a shelter shed, not the most favourable location.

The FM duplex signals were readability five, strength nine both ways. The frequencies used were 30MHz apart with VK2AHC operating on 5840MHz and VK2SB / VK2ZND on 5810MHz.

The electronics used was that described in articles written by Des Clift published in "Electronics Australia" May-October 1972. In this case, both used a 3dB coupler system, similiar to Fig 2(a) on p55 in May.

The antennas were home made horns, 17" by 13" aperture, 28" long, and with gains of 23dB. These were fed by 3dB couplers made from WG14, with single IN23E crystals in the side arms.

The Klystrons were retuned RK549's salvaged from some surplus Collins equipment, and fed to ferrite isolators. The stability was excellent, and the signals were superior to signals exchanged the same day over the same path on the 10GHz and 3400MHz bands.

In the note received from Des on the experiments, his comments were:—

"It would have been most interesting to have been able to have an earlier QSO in fine weather and compare it with the one we had in the rain.

"I now hope to combine the best features of both sets to produce one really good set, and then work on a completely solid state unit for at least 3400MHz and 5800MHz bands (ie no Klystrons), and push up some of these distances during the coming year."

The latest information on hand gives the distance record in the United Kingdom as 78Km, a figure achieved in June 1972. The world record of 344Km was set in the USA in June 1970. There is no record set down for that band in Europe.

Shown above is one of the home made antenna horns used in establishing the record contact, together with the transmitting equipment. (Courtesy VK2AHC).

2 METRE BREAKTHROUGH

Some brief comments on a two metre breakthrough were given in the February, 1974 issue of these notes. A letter recived from Ron Kerle, VK4EN, has now clarified the incident which was a far greater achievement than it appeared to be at the time news of the breakthrough was received.

What actually happened, and the subsequent contacts made, are as related by Ron, whose location is Mackay, Queensland.

"While working stations on six metres on 22nd December 1973, I heard some Sydney stations coming through on 146MHz but was unable to break in. I then went back to six metres and called the first VK2 station I heard. This was Carl Palmer, VK2ZGX, located at Warrawee, just north of Sydney.

"When Carl, as requested, came up on 146MHz I was able to copy him — readability 5, signal strength 9. He reported my signals the same and a two way contact was made.

"After signing with Carl, I was called by Eddie Penikis, VK1VP, in Canberra, his signals also being — readability 5, signal strength 9. His report to me was R4 — S5.

"Later I again tried to work Carl on 146MHz but was unsuccessful. However, we were still in contact on six metres and it was at this time that Errol Trimmingham, VK2BET, on 146MHz was relayed by Carl to me via six metres.

"On the 8th January, 1974, four Melbourne stations were worked on 146MHz. These were: VK3AYK; VK3YDB; VK3YSK and VK3YDO."

The power output on 146MHz from Ron's transmitter is 4 watts. No details were given of the aerial used or signal strengths of the Melbourne contacts. The distance achieved during the Melbourne contacts is approximately 1,900Km. Congratulations to Ron for a fine effort.

REGION II NEWS

United States: What has been referred to as ". . . 'A hint of a major re-vamping of the amateur licensing structure as it now exists" in the United States was the theme of the editorial in the February 1974 issue of "CQ" magazine.

Although no statement has been made by the Federal Communication Commission (FCC) it is suggested in the editorial that a likely proposal will be:

"To begin with, amateur radio will be offered, for the first time, a code free beginners class (probably called Communicator's Class) licence with operating privileges in the VHF or UHF regions, probably beginning at 220MHz.

"Such a licence will open the door to thousands of newcomers, who will be offered a chance to join the amateur fraternity on a legal ground-floor level rather than become Citizen's Band anarchists. Hopefully, they won't become amateur radio anarchists."

The article then puts forth the likely possibility of there being as many as seven classes of licence each progressing to a higher grade by either a higher Morse Code requirement or a higher grade theory pass.

If the prognosis is correct, these will be the grades from highest to lowest.

"Amateur Extra-CW: 20WPM code, Extra Theory. All amateur privileges.

"Amateur Extra-phone; 10WPM code. Extra theory. All amateur phone privileges. General / Advanced CW privileges.

"Advanced: 10WPM code, Advanced theory. All current advanced class privileges.

"General / Conditional: 10WPM code. General theory. All current General Class privileges.

"Technician: 5WPM code. General theory. All present Technician privileges plus those mentioned above.

"Novice: 5WPM. Novice theory. All present Novice privileges.

"Communicator: No code, Novice theory. Limited phone privileges above 220MHz."

The Novice and Communicator licences are to be non-renewable.

Whether any of these suggestions will take place is pure conjecture at this stage. However, changes will be made and it would appear that American amateurs will have to give the matter some deep thought.

REGION III NEWS

Australia: Many amateurs have expressed the hope that the Federal Convention of the Wireless Institute of Australia, to be held in Sydney, NSW over the Easter weekend 1974, will give priority to matters that will improve the status of amateur radio.

It is further hoped that action will be taken to ensure that the Region III Association becomes a viable organisation prepared and able to play its part on the international scene.

RADIO CLUB NEWS

Moorabbin & District Radio Club

The president's report for 1973 states that the year had been one of continued progress and, in general, the outlook for the future of the MDRC looks quite bright.

During the year $2000 was passed to the Moorabbin Council as payment for the clubs share in the combined clubrooms now under construction.

The formation of a ladies group resulted in the promotion of social activities which greatly assisted the club's funds.

The activities of the MDRC during 1974 will be under the guidance of David Rosenfield, VK3ADM, who was elected president at the annual general meeting.

It was noted with interest that the name of an old friend Ken Pincott, VK3AFJ, appears among the club's list of office bearers for 1974. Ken is an Honorary Life Member of the WIA, and for many years was editor of the WIA publication "Amateur Radio".

Subscriptions to the MDRC are: Senior members $5.00 per year. Junior members $2.00 per year. Full details are available from Secretary, Michael Park,

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown, 2200.

AMATEUR BANDS

VK3ASH, 41 Hilburn Grove, East St Kilda, 3182. Telephone 52 5336.

Eastern Zone — VK3

Discussions on new boundary proposals affecting the Eastern Zone of the Victorian division, WIA, have taken place. Representatives of the zone at the discussions were Bruce Hocking, VK3ADB; Ted Allchin, VK3YGI and George Francis, VK3ASV. It is proposed that the new boundaries follow those used by the Country Fire Authority, in which case the Eastern Zone will encompass CFA regions 9, 10 and 11. Other areas previously a part of the zone will become part of a new zone. Amateurs living near zone boundaries will be able to register in the zone in which their interests lie.

An extensive survey has been carried out by George Francis, VK3ASV, for possible locations for the resiting of the Latrobe Valley repeater VK3RAB. An experimental repeater constructed by George, together with a nine metre mast carrying dipole antennas, was used in the survey. However the problem may now be resolved. Following lengthy negotiations with the Postmaster General's Department, the zone has obtained permission to operate the repeater from the site of television station ABV4. The aerials for the repeater are to be mounted on the main transmitting mast, with the repeater unit installed in the channel 4 building. The aerials must be installed by PMG riggers, while amateurs employed at the station will be permitted to install the repeater. The project will cost $500.

Following a decision, made at the special meeting of the WIA Federal Council in September, 1973, to change repeater frequencies, the new frequencies for VK3RAB are: input 146.2MHz, output 146.8MHz.

During the summer months, conditions on the six metre band were the best for eight years. Gippsland six metre operators made contacts with all Australian states and New Zealand. However, due to the possibility of causing TVI, operation on the band did not take place after 6.00pm.

In order to minimise the possibility of causing TVI to channel O viewers, a proposal has been made to use 53.995MHz instead of 53.032MHz as the AM net frequency.

The Eastern Zone hookup is held every Sunday evening on 3650KHz at 2100 hours summer time, reverting to 2000 hours during winter. The official zone station call sign is VK3BEZ.

For details of zone activities, write to the secretary, Harold Hardy, VK3YGJ, 1 White Parade, Churchill, Vic. 3842.

Illawarra Branch — VK2

The moon bounce project co-ordinator at the Illawarra Branch Lyle Patison, VK2ALU, reports that a linearly polarised feed system was installed in time for the E-M-E tests scheduled for 5th January with K2UYH and W6FZJ. However, only echoes of their own signals were heard.

Advice was subsequently received from K2UYH that the dish of his antenna was filled with ice and snow from a storm the previous day.

Lyle reports that signals received on linear polarisation have entirely different characteristics from those received on circular polarisation. However, with the choice of separately polarised dipoles at 90 degrees displacement, it is possible to obtain continuous signals from one or the other. The remote feed dipole switching is working well.

Unidentified signals were heard from the direction of the moon on January 2nd. They sounded like audio "motorboating" modulation and were quite strong. Enquiries are being made in an endeavour to have them identified.

The RTTY system has been completed to a stage where HF signals can be copied. AFSK can also be transmitted on two metres. However, the RTTY Moon bounce project has come to a halt until a new transmitter frequency source crystal oscillator is constructed.

There are now ten stations in the USA engaged on 432MHz E-M-E experiments, and arrangements are being made to schedule a larger group for future tests. The latest letter from OE6AP in Austria indicates that he hopes to be ready for E-M-E tests about the middle of 1974.

For information on all activities of the Illawarra Branch, write to the secretary, Ian Bowmaker, VK2-ZJA, 15 Akuna Street, Keiraville, NSW, 2500.

Western Australian VHF Group

Several senior officers of OTC made a visit to the Wireless Hill museum project during the Jamboree-on-the-Air weekend. The visitors expressed great interest in the project and, as a result, an interesting display will be made available to the project. It seems likely that a ten foot square floor area will be required to mount a display explaining the operation of communication satellites.

The group meets in the Wireless Hill Museum building on the 4th Monday of each month. Visitors are welcome. Write to secretary, Tom Berg, VK6ZAF, 23 Beach Street, Bicton 6157 or telephone 39 3614 for further information.

University of NSW Amateur Radio Society

The February "News Sheet" of the University of NSW Amateur Radio Society contained some very interesting information on the club's activities during the Christmas vacation. It was also pleasing to read that the publicity given in these notes was helpful. It appears that a somwhat different approach was made to introduce newcomers to the various facets of amateur radio.

UNSW Amateur Study Classes

The first classes organised by the society were held from 14th December 1973 to 28th January, 1974, in the Electrical Engineering building. The aim of the study classes, an activity which the society hoped to organise during each end of the year vacation period, is to assist persons in obtaining their amateur licence.

During the course, a large amount of time was set aside to explain the various activities of amateur radio. The most successful approach was to present a topic e.g. amateur operating activities and allow the students to express their own thoughts and ideas. The job of the supervisor was simply to direct discussion on topics such as emergency communications, experimenting, DX'ing etc. The ARRL Operating Manual proved to be very helpful.

Activities of the study classes included: subjects required for the AOCP or AOLCP, DX contacts on several HF bands, portable operation on eleven, six and two metre bands, erection of dipole antennas, demonstration of home built projects for the beginner, and the display of home built SSB HF and VHF FM transmitters and receivers.

In addition to the study classes at the University of NSW, demonstrations of amateur radio were given by members of the society to the Sylvania High School Electronics Club, the Northcott School for Cripple

Children, and the North Rocks School for Blind Children.

Sam Voron, VK2BVS, president of UNSWARS, addressed twenty members of the Sylvania High School Electronics Club (SHSEC) at their inaugural meeting. As a result of the discussion, the SHSEC proposes to start YRCS activities early in 1974.

Following an inquiry from the occupational therapist at the Northcott School for Crippled Children at Parramatta, several members of UNSWARS gave a demonstration of amateur radio. Some fifty boys and girls, aged from six to sixteen were given their first opportunity to speak over a radio station. After learning some details of the Youth Radio Scheme and the proposed novice licence, steps are being taken to include the YRCS novice licence course in the school syllabus.

A similar request was received from the principal of the North Rocks School for Blind Children. Again a demonstration was organised by UNSWARS which created a great deal of interest among the staff and students. The school is now considering the establishment of amateur radio classes as part of the normal school syallabus.

In fact two blind students, Graham Innis, who has completed sixth form, and Bruce Maquire a sixth former, joined the UNSWARS study group. They both aim to be able to do oral tests to obtain their amateur licence.

Central Coast Amateur Radio Club

The 1974 annual field day of the Central Coast Amateur Radio club was the most successful yet held. A record attendance of 530 registrations was reported, with many amateurs attending for the first time. It was surprising the number of "Old-timers" who were present, renewing acquaintances of a decade or more ago.

The many field events were keenly contested, with successful competitors being rewarded with excellent prizes.

Trade displays of a large array of components and equipment created a lot of interest, as did the disposal sale and a demonstration of amateur colour television.

Westlakes Radio Club

A three term course, designed to enable students to reach the AOCP standard, is available at the Westlakes Radio Club. The course, run in conjunction with the Hamilton Evening College, is conducted at the WRC, Ranclaud Street, Booragul.

Classes are held on Monday and Wednesday evenings from 6.15pm to 8.15pm. Fees per term; $10.50. Telephone 58 1588 for further information.

Work on the conversion and renovation of the building acquired by the club, now located in York Street, Teralba, is progressing very rapidly and it will not be long before all club activities are transferred to the new address.

Write to secretary, Eric Brochbank, VK2ZOP, for details of YRCS and other club activities.

Maitland Radio Club

The new series of technical instruction in radio and electronics at the Maitland Radio Club has resulted in the biggest attendance of beginners in the club's history. Interest among people of all ages in the club has grown considerably since the recommencement of activities in 1974.

To assist the club with its technical and practical training classes, Mr Bill Jenvey, VK2ZO, a retired radio engineer and amateur operator, presented the club with a completed single side band transmitter, together with other receiving and test equipment. The

For further details, contact the Secretary, Box 59, PO East Maitland, NSW 2323.

LOCAL & OVERSEAS NEWS
Interesting Statistics

It is not very often that statistical information associated with amateur radio at a local level comes to hand. Although these statistics are the result of only relatively small sampling, they do provide some interesting facts.

To assist the University of NSW Amateur Radio Society to plan and promote future study classes, a survey was made of those attending the classes organised during the 1973 / 74 Christmas vacation.

The results of their survey are set out below.

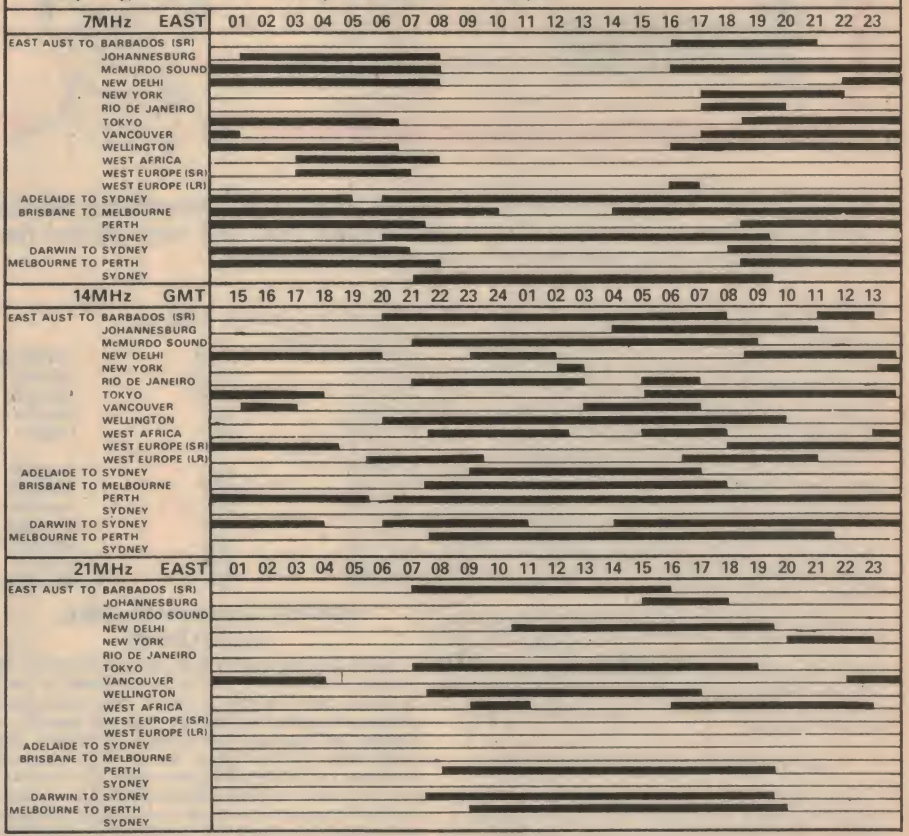
- The age range of the 78 persons who enrolled for the course was from 13 to 23 years with one over 40 years, the highest number being in the 17 to 20 year age group.
- By far the greater number first heard of amateur radio before they were 12 years old.
- Of those attending, 34 were high school students, 22 were working full time (50pc being engaged in electrical work), 15 were university students, (50pc electrical engineering), 6 technical college students, and one retired person.
- Those in the non-electrical category were engaged in the following trades or professions: chemist, building, real estate, teaching, housewife and students studying medicine, mechanical engineering and accountancy.
- How did those attending find out about the classes?

28 directly from society members.
18 from reading "Electronics Australia."
13 from friends.
8 from society leaflets.
7 from the WIA.
4 from newspaper story.

- Thirty-five did not know Morse code was compulsory for a full licence.
- Fifty-four wished to obtain the full licence and 20 the limited licence.
- Twenty three had operated an unlicensed transmitter.

IONOSPHERIC PREDICTIONS FOR APRIL

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Commonwealth Bureau of Meteorology. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 4.74



Certificate Hunters Club

The first of the basic "ACE Awards" based on the Australian Commonwealth electorates has been issued to ZL2AH, who now has the distinction of holding certificate number one. By the beginning of February, 1974, certificates two to nine had been issued in the following order, VK8ZZ; ZL2IK; ZL3SX; VK8KP; SWL, C. H. Thorpe (the first shortwave listener); VK5EX; VK3APU and ZL1HN.

Contacts made with Australian stations after 1st January, 1974 are eligible for ACE awards but must be confirmed by a QSL card (see page 113 "Electronics Australia" August 1973, for details).

The Certificate Hunters Club, which sponsors the ACE Awards, has appointed "Electoral Referees" to assist amateurs and shortwave listeners to identify the electorate in which amateur stations are located.

Anyone holding QSL's but not knowing the electorate of the station concerned may write to the appropriate state referee giving the following particulars of the station:

a. Call sign
b. Address shown, including street number, suburb, town etc.
c. Post code.

Each referee holds a copy of the official electoral boundary maps for his state, whilst Alex Slight, VK2ZA, holds maps for the whole of Australia. A stamped, self-addressed envelope should be included with each request for information.

The electoral referees are:

A. A. B. Slight, VK2ZA, 31 Lamrock Avenue, Bondi Beach, NSW 2026.
J. C. Gutcher, VK3APU, 17 Foulds Court, Montrose, Vic. 3765.
L. Bell, VK4LZ, Airlie Beach, Queensland 4800.
H. A. Fisher, VK5EX, 113 17th Street, Renmark, SA 5341.
R. G. B. Vaughan, VK6RV, 29 Tonbridge Way, Morley, WA 6062.
A. N. Richardson, VK7NR, 69 Georgetown Road, Newnham, Tas. 7250.

New Zealand amateurs and shortwave listeners should contact; L. D. McMillan. ZL 2IK, 7 Duke Street, Levin.

Shortwave Scene

by Arthur Cushen, MBE

The Voice of Chile in Santiago has introduced a new International Service, and is broadcasting in eight languages. Signals from the new service have been received at fair strength in Europe and New Zealand.

The Voice of Chile at Santiago is using four frequencies, and has been heard during two transmission periods. One service commences at 0900GMT in German, and then follows Italian at 0920GMT, French at 0940, and English at 0955GMT. During the English transmission the station announces that they are operating in the 19, 25, 31 and 49 metre bands, and requests reports to Casilla 244V, Santiago, Chile.

The best reception is on 6195kHz, though it is known that 9510 and 15150kHz are also operating at this time. The reception is good up to 1000GMT when interference is observed from the BBC relay at Tebrau. In the period up to 1100GMT programs in Russian, Arabic, Spanish and Portuguese are broadcast, but the schedule and the timing of various languages is not always the same each day.

In Europe the Voice of Chile has been heard from 2045GMT to sign off at 0500GMT and, although they are announcing on 15150 and 6190kHz, they have been heard only on 15150kHz. The BBC monitoring service reports reception in Europe at fair strength, and during our winter the service up to 0500GMT should also be audible.

RADIO SUPER ON 5950kHz

Radio Super in Bogota, Colombia, has been operating around the clock for the last two years on 6065kHz, and has verified reception of their signals by many of our readers. We have recently heard a second station announcing as Radio Super, and this one is located in Medellin and uses 2950kHz. Reception after 0700GMT has been good up to 0800 when some side band from Paris on 5955kHz is observed. At 0845GMT this interference is increased when VOA Dixon operates for 15 minutes with a program from UN Radio beamed to the South Pacific.

IDENTIFYING SIGNALS

This year, Radio Canada's Short-wave Club is to feature two interesting programs over a series of several weeks. The first will be recordings of various foreign languages and their identification to help the new listener in recognising some of the more frequently heard languages on short-wave.

The second is a series of station interval signals used by short-wave broadcasters, and these will be heard later this year. This has been a popular feature in recent years, with most of the signals being recorded at monitoring stations. This year, in order to improve the quality of the signals, various broadcasting stations will provide high-quality copies of their own signal to ensure the listener the best possible reception. The Club program is heard on Saturday at 0915GMT on 5970 and 9625kHz.

KGEI TO USE 250kW

Station KGEI in San Francisco is shortly to introduce a new 250kW transmitter. According to the station, this transmitter will be operating next month, and will be used for the service to Latin America and Asia.

Late last year the station, which is operated by the Far East Broadcasting Company, commenced a service to Asia. Current plans are to make frequency changes in this service so as to utilize the 6MHz band. The address of the station is PO Box 15, San Francisco, California, 94101, USA.

The latest schedule of KGEI is:

To Latin America

GMT	kHz	Language
1700-2145	15175	Spanish
2145-0130	15280	Spanish
0130-0630	9615	Spanish
0630-0700	9615	English

To the Far East

0700-0900	9585	English
0900-1000	9585	Russian
1000-1100	9520	Russian
1100-1200	9520	Japanese
1200-1400	9520	Mandarin
1400-1500	9520	English
1500-1700	9520	Mandarin

RADIO NACIONAL DEL ECUADOR

One of the first stations to be covered in Andex, the bulletin of the Andes DX'ers International, is Radio Nacional Del Ecuador in Quito. This government station was opened on May 24, 1961, and operates on 640kHz medium-wave and 4945kHz short-wave, both using 10kW. The short-wave service is in two transmissions, 1100 to 1500 and 2300 to 0400GMT. Programs are devoted to cultural information and government announcements, and at times when special events are in progress the transmission time is extended past 0400GMT.

Plans are under way to establish a network in Ecuador by Radio Nacional, but this will be on medium-wave, though the short-wave service could also be expanded. Reception reports should be sent, preferably by airmail, to Radio Nacional del Ecuador, Casilla 82, Quito, Ecuador. The station now confirms reception with a card, but when we heard the initial broadcasts a letter and pennant were received.

THAI WEATHER STATION

The 10kW Bangkok Meteorological broadcasting station on 7863kHz has been well received during its evening transmission. According to a station announcement, they have extended their schedule and operate from 0000-0330 and 0600-1330GMT. The program consists of weather and shipping news, together with popular English and Thai music. Reception reports from listeners should be sent to Meteorological Department, Telecommunications Division, Sukumvit Road, Bangkok 11, Thailand.

The frequency is well outside the recognised short-wave bands, and is therefore subject to severe interference from morse signals in the vicinity.

IRAN USING 9022kHz

English broadcasts from Radio Iran, broadcasting from Reheran, have been heard on the off-band frequency of 9022kHz. Transmission in English is observed at 2000GMT with a news bulletin, followed by a commentary and then a travel talk on Iran.

The broadcast ends at 2030GMT when it is followed by a service for Iranians abroad. This frequency suffers interference from Radio Peking.

KAVIENG VERIFIES

One of the latest stations in Papua New Guinea to come into operation is Radio New Ireland at Kavieng. The station broadcasts on 2428kHz, uses 2kW, and is on the air 0745-1230GMT Monday to Friday and 0645-1230GMT on Saturday and Sunday.

According to the verification letter, the address is Radio New Ireland PO Box 140, Kavieng. Station Manager Joseph Gohan reports that they broadcast news in pidgin English, Papua New Guinea music, country and western music, Islands music and current affairs programs. Their extension programs cover health, agriculture, political education, social development and other rural programs. The present staff consists of five women and ten men, and all announcing and program preparation is done by Papua New Guinean Officers.

MEDIUM-WAVE NEWS

HAWAII: Medium-wave changes include two more all-night stations KOHO 1170kHz, 5kW, and KZOO 1210kHz, 1kW, both 24 hour operated with Japanese programs. KPUA 970kHz 5kW at Hilo is now also 24 hour operated. KIPA 1110kHz 1kW has extended its hours to sign off at 1100GMT according to Tim Hendel of Honolulu.

PHILIPPINES: A new station has been observed on 1570kHz and our reception has been up to 1600GMT sign-off. The station is DYRG Bacolod City and, according to the announcements, they operate on a radiated power of 5kW. DYRG is a member of the Cadiz Radio and Television Network, which has several other stations operating throughout the Philippines.

MALTA: According to Sweden Calling Dxers, the Broadcasting Authority of Malta started regular broadcasts recently. They use a 5kW transmitter on 998kHz, and are heard continuously from 0730 to approximately 1900GMT. The programs are in the Maltese language. The station has verified a report with a letter. The Deutsche Welle relay base on Malta has started test transmissions, at present operating around 1700-2200GMT. The station gives announcements every half-hour, indicating the frequency to be 1570kHz.

MALAYSIA: According to Bob Padula of Melbourne, who was recently in Malaysia and Singapore, the new Kotakinabalu station is well heard in that area. This new transmitter operates on 1475kHz and opens at 1100GMT with a service to the Philippines. Reception of this signal has not only been heard in New Zealand, but as far away at the West Coast of North America, indicating a high power transmitter.

SOUTH KOREA: Station HLDA, run by the Far East Broadcasting Company, operates on 1570kHz with 250kW. The station is located on Cheju Island, and commenced operation on a restricted schedule on June 30. Early this year the station received approval to expand its broadcast times, and has recently been heard closing at 1630GMT. The program schedule is: 1030-1130GMT in Korean; 1130-1430 in Chinese; 1430-1545 in Russian and 1545-1630 in Japanese. The address is IPO Box 3939, Seoul, South Korea.

LISTENING BRIEFS

AFRICA

ALGERIA: According to Sweden Calling Dxers, Radio Algiers now has a daily program in English from 1900-1930GMT. This is broadcast on long and medium-wave, and the short-wave frequencies are 11910, 15160, 17745, and 17825kHz. The Arabic service at 1600GMT has been noted on 17790, 17880 and 21565kHz. The French service has also been heard at the same time on 17825 and 21715kHz.

LIBYA: The biggest short-wave station in Africa will be erected in Libya. There will be 4 short-wave transmitters of 500kW each, powered by diesel generators, and 48 curtain antennas for beams to all parts of the world. The station will be completed in June of 1975.

SIERRA LEONE: The Sierra Leone Broadcasting Service has been heard by several Wellington listeners, according to the New Zealand DX Times, with reception on 5980kHz at 0800GMT. Dean Lynneberg reports that the station has an announcement at 0800 which is "You're tuned to the Sierra Leone Broadcasting Service, Freetown. The time now is 8 o'clock." Brian Clark reports that the station opens at 0746GMT, and has English recordings and commercials.

SOMALIA: Radio Somalia, Hargeisa, has been noted by John Mainland of Wellington, NZ, on 11663kHz around 1555GMT. The station is heard in Somalia news at this time with frequent identification.

AMERICAS

GREENLAND: According to a verification, Radio Greenland has a new schedule as reported in Sweden calling DXers.

GMT	kHz
1000-1200	3999, 9575
1900-0300	3999, 9575
1200-1900	5960, 11740
1000-0300	5980.

The broadcasts are in Danish and Greenlandic, and each language has eight hours transmission daily.

COSTA RICA: Station TIFC at San Jose is using the new frequency of 6175kHz with programs in English at 0400GMT. The usual frequency of 9645kHz carries the same porgram as the new outlet.

Further details on other stations, and information on what is being heard by readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT, add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

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QLD.	30c	60c	70c	70c	80c	80c	$1.00	$1.00	$1.00	$1.00	$1.00
NSW. NT. TPNG.	30c	85c	85c	85c	90c	$1.00	$1.20	$1.40	$1.60	$1.80	$2.00
VIC.	30c	$1.00	$1.00	$1.00	$1.20	$1.50	$1.80	$2.10	$2.40	$2.70	$3.00
SA. WA. TAS.	30c	$1.10	$1.10	$1.50	$2.00	$2.50	$3.00	$3.50	$4.00	$4.50	$5.00

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STEREO AMPLIFIERS 9v DC suppl.

3 watt with tone and vol. controls (as illus.) $13.95.

All above with full diagrams and instructions. 6 watt with tone and vol. controls $17.50

AUDIO AMPLIFIERS FROM $4.95 1lb

2 watt English	$4.95
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15 watt (as illus.)	$11.50
35 watt	$27.50

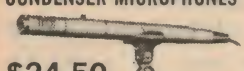
FAMOUS ENGLISH E.M.I. HI-FI SPEAKERS $11.50

13 1/2" x 8 1/2" complete with tweeter. Handles to 10 watts, 8 ohm impedence. 55-11,000 H.Z.; Brand New in cartons, 1974 production. Has ceramic magnet. 4lb

Special! 4 Channel QUAD ADAPTORS $24.50

First time in Australia. Converts your 2 channel stereo to 4 channel quadraphonic sound. Just add 2 speakers. Adjustable sound effect of rear speakers. Has effect suited for surround or concert hall. This is true quadraphonic sound. Max input 50 watts. 2 lb.

Fantastic Purchase! CONDENSER MICROPHONES



$24.50

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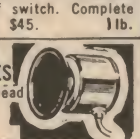
INDUCTION MICROPHONES complete with lead and plug **$2.45**



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2lb. **$9.95**

Famous make solid state INTERCOMS — Two station intercommunication system comprising master and sub-station. A faultless unit with volume control and connecting wire. Fully transistorised. Has press-button buzzer on each station. Operates up to ¼-mile. Battery operated. Neatly packed in cartons.

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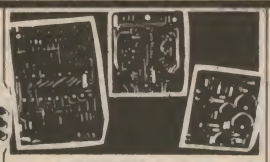
Made by "Meccano" England. Input 15 volts AC, output 0 to 12 volts DC in fine smooth control. Has 8 speed control positions in both normal and reverse.

Unit is a step resistance, rectifier controller for up to 2 amps. Also for reverse and has off pos. and pulse power switch for ultra slow running. Ideal for models etc. new in carton with instructions and guarantee. Worth $9. 1 lb



COMPUTER BOARDS 2lb

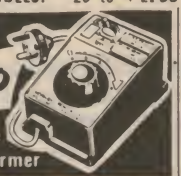
Set of 3 comprising 2 boards 7" x 5" with 1 board 5" x 4" comprising minimum of 25 transistors plus hosts of diodes, resistors, capacitators, inductors, etc. $3.95 set of 3. 2lb

$15.95

Famous 200 H Model 20,000 OHMS MULTIMETERS 1lb

Extremely sensitive 20,000 ohms complete with full instructions and probes with overload protection RANGES:— D.C. VOLTAGE: 5-25-50-250-500-2.5K (20,000 ohms per volt). A.C. VOLTAGE: 10-50-100-500-1000 volts (10,000 ohms per volt). D.C. CURRENT: 0-50 uA, 0-2.5 MA, 0-250 MA. RESISTANCE: 0-6K, 0-6mg. (300 ohm and 30K at centre scale). CAPACITANCE: 10 uuF to .001 uF, .001 uF to 1uF. DECIBELS: -20 to +2208

$10.50



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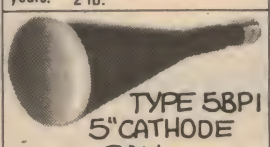

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Brand new in mfrs. carton

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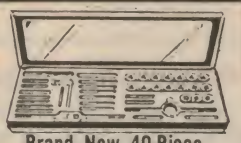

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40-piece stock and dies covering the full range S.A.E. and WHIT. in the one box. TUNGSTEN STEEL 1/8"-1/2". Complete with dies, stock, tap wrench, tap holder, pitch gauge, driver—in strong metal cas A bargain. 1/2 price. 4lb

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Miniature on/off glow tube anode 60 volts max. and 750 microamp. max. Grid - 3 volt D.C. max. Wire end tube directly heated 1 volt 30mA.

50 volts anode. Zero grid volts 550 microamp. Anode current tube glows. With 3 volts on grid tube off anode current then 5 microamps. 4oz.

Electrically operated WATER VALVES $2.75

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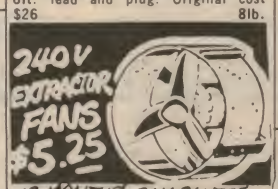
Inlet ¼in. Outlet ½in BSP. 3 1/2in. long x 3in. overall.

"Meccano" Power Units $9.50

Type 8156. Beautifully made in England by this famous manufacturer. 240 volt A.C. mains input gives 26 volts at .63 amp. and 26 volts at .63 amp. output. Complete with two adjustable accelerators (resistors), each with approx. 3ft. of cord, that control output voltage. Housed in metal case. Brand new in carton with instructions. 6ft. lead and plug. Original cost $26 8lb.

240V EXTRACTOR FANS $5.25



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Brand new English 240 volt A.C. mains operated fans. Make ideal extractor fans for kitchens, caravans and other domestic and light industrial purposes. Continuously rated, smooth, silent-running induction motor. 4,000 r.p.m., balanced 3-bladed, 6½" fan. Size 6½" dia x 4" deep. 3lb.

FRESNEL LENSES $4.50

12 in. sq. x 1 mm. thick. f.l. 13, 1/2 in.

Precision worked in thin optical plastic and providing large area magnification equivalent to expensive glass lenses. Fine optical quality permits use as solar furnace elements, condensers, image magnifiers, light intensifiers, overhead and back projection optics, camera image brighteners (disco scenes). Use our low RPM geared motors to drive these. 8oz.

Double Fresnel Lenses (condenser) same size as above $7.50 1lb.

$7.50

MICROMETER ADJUSTING BUBBLE CLINOMETER

This high-precision Clinometer, made to stringent govt. specifications in gun metal, is graduated with a 20° scale and movement. From dead centre, a fine reading can be taken to the nearest ½ minute by the micrometer thimble.

HAIR TRIGGER SWITCH MATS

- Wafer thin—undetectable under door mat or carpet.
- Operates by foot pressure over any part of surface.

Tough polythene envelope has sealed-in multi-strip contact ribbon that completes a circuit whenever anyone—even a small child—steps on to mat under which it is concealed. Ideal for burglar alarms, customer entry warning in shops, automatic door opening switch. MAX VOLTAGE 50V. MAX CURRENT 1AMP. 144 CONTACTS PER SQ FT.

Door mat—29in. x 16in. **$5.95**

"PLESSEY" MICROSWITCHES $1.25

Brand new with long flying leads, removable mounting bracket. 5 amp. at 240 volts A.C. 2oz.

UNIVERSAL SELECTOR 24—48 VOLT solenoid operated

FIRST EVER RELEASE. Provides dozens of switching selections. A must for all electrical hobbyists.

9 bank +	.... $8.50
4 bank +	.... $7.50

brand new in boxes. 2lb

WRITE FOR OUR NEW FREE 16 PAGE CATALOGUE

HOMODYNE TUNER KITSET

Discrete component version from November W.A. **$24.00**

MUSICOLOUR: The Mk 2 model from Electronics Australia. 3 channel, 6 amps max per channel. Self-contained with its own driver amp. Requires only a small signal voltage to operate it. Kit contains printed circuit board, transformers & components, but no plugs, sockets, or metalwork. **ONLY $47.40**

Philips Discrete Component Preamp: All the components, including print circuit board and anodised front panel for a really high quality low noise stereo preamp. The noise ratio on magnetic input is better than 90db. Here are the specs. . . .

INPUT	SENSITIVITY	INPUT Z	FREQ RESPONSE	UNWEIGHTED S / N RATIO
Crystal pickup	300mv	1m ohm	10hz-35khz	>80db
Magnetic PU	4mv	47k ohm	10hz-45khz	>90db
Radio tuner	150mv	500k ohm	10hz-35khz	>80db
Tape recorder	300mv	500k ohm	10hz-45khz	>85db
Mag mike	3.5mv	22k ohm	10hz-65khz	>80db

COMPLETE STEREO PREAMP KIT FOR ONLY **$19.85.**

VHF KITSET: One transistor, super-regenerative, receives Police, taxis, aircraft, etc. Pictorial instructions supplied. Works through an ordinary transistor radio without connecting wires. Heap big magic, eh! **$5.40**

SILICON POWER TRANSISTORS: Types BD433 / 434 Philips brand. Will supply 8 watts RMS from 12 volts. Suitable for car radios, modulators, etc. Supplied with suitable circuit. **$2.50**

LE.D.: Light emitting diode. Miniature point source type. Hewlett Packard part 5082-4487. Operating data supplied. Runs off 1.6 volts. **47c** each or 5 for **$2.00**

ITEMS REQUIRED.....

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We regret that due to currency regulations we cannot accept personal cheques.

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P.O. BOX 27 037, Wellington, New Zealand.

MONEY BACK IF NOT COMPLETELY SATISFIED

DEAR KIT PARTS —PLEASE RUSH MY ORDER —THIS BATH IS GETTING COLD!

STOCKTAKING BARGAINS

Bridge rectifier BY122 0.8 amp 50 volt 3 for **$1.00**

Preset wafer pots 10k ohms 10 for **$1.00**

Electrolytic. Can type 50 + 50 ufd 400 volt 3 for **$1.00**

Electrolytic. Can type voltage doubler 100ufd 200 volts 2 for **$1.00**

Electrolytic. Insulated blue tag type 25ufd 450 volt 5 for **$1.00**

Electrolytic. Pigtail type 32ufd 350 volt 5 for **$1.00**

Electrolytic P.C. type 400ufd 10 volt 10 for **$1.00**

Electrolytic P. C. type 10ufd 300 volt 6 for **$1.00**

Ducon polyster PC capacitor 0.1ufd 400 volt 10 for **70c**

25 WATT STEREO POWER AMP

This kit utilises the Sanken hybrid power amps and is supplied complete with surrounding components. It matches the above Philips preamp but can be driven off any quality preamp. Power supply not included. **$44.00**

— VALVES —

5U4GB	**$1.35**
6B7	**$1.25**
EZ80	**.80**
6DT6A	**$1.20**
80	**$2.00**
PCF82	**$1.65**
PCF86	**$1.35**
6EM5	**$1.50**
1B3GT	**$1.35**
PL36	**$1.20**
PL84	**$1.20**
ECH84	**$1.80**
PCC88	**$2.40**
EZ81	**.80**
EAA91	**.75**
5AS4	**$1.35**
35L6GT	**$2.80**
12BA6	**$1.50**
12BY7	**$1.60**

INFORMATION CENTRE

MOVIES, SLIDES: Congratulations on the fine series by N. Labordus on "Synchronisation of Taped Sound with Home Movies" commencing in the November '73 issue of your magazine. At present, I am working on this project. At the same time, I was wondering if you are going to update the "Tape actuated relay" project of September 1967 (File No 2/MS/11) which used reflective tape as the control medium. Several of my acquaintances would be interested building such a control system for slide projectors but using a system of low frequency tones on the tape. (J. S., Ashwood, Vic.)

Thank you for your favourable comments on the magazine. Regarding the slide projector tape control system, we will add it to the long list of projects for future consideration.

YOUNG EXPERIMENTER: Although I am new to electronics I can see great expense. I have ideas for young people to cut costs for project building and servicing, and I would like to hear from anyone interested between the ages of about 14 to 17.

Thanks for a great magazine and I must congratulate you on the Playmaster 136 — keep up the good work. Could you please print my name and address? (Allan Clark, 110 Park Rd, Kogarah Bay, NSW 2217.)

Thank you for your compliments. As requested, we are printing your name and address.

GALENA CRYSTALS: Re "Cat's Whiskers," page 125 "Electronics Australia" December 1973. At 8.10pm (Brisbane time) on Saturday 5/1/74, I heard on 4QR, on "Sentimental Journey," a gent recollecting a few facts about "wireless" receiving sets which he used to "lash up" in 1922. "Crystal sets — to make a 'crystal' for a crystal set, melt down a couple of 'lead soldiers' and toss in a couple of handfulls of 'flowers of sulphur'."

According to my old "Westminster" dictionary (Collins) page 994, "flowers of sulphur is a yellow powder formed by condensing the vapour of sulphur." Also page 412 of same source: "galena — sulphide of lead; the principal ore from which lead is extracted. In wireless, used as a crystal detector."

Source to procure —
1. make your own;
2. request a science master friend to make one;
3. request a chemist friend to make one;
4. gold mines often have lead as well as gold;
5. Mount Isa Mines has gold and lead as well as copper;
6. a smelter.

Hope the above is of use to you. Keep up the good work. (D.C., Brisbane, QLD.)

Thank you, D.C. for those comments. It appears that the basic idea of your "recipe" is to produce lead sulphide or galena, in crystal form. We feel that "recipes" of this type are of doubtful value, but no doubt could lead to interesting experiments.

AMATEUR RADIO: I have just started in Amateur Radio (good hobby) but several terms have me stumped. They are "front end," "fundamental," "harmonic" and "overtone." Could you please define them? I enjoy reading your magazine and I find your "Eelementary Electronics" most helpful. (T. M., Coffs Harbour, NSW.)

Thank you for your appreciative comments, T.M. The term "front end" generally refers to the section of a radio receiver which comes before the intermediate frequency (IF) section. "Fundamental" refers to the major or lowest frequency in a periodic waveform. A harmonic is an integral multiple of the fundamental frequency, ie, the second harmonic is double the fundamental. An "overtone" is also an integral multiple of the fundamental except that the first overtone is equal to the second harmonic, the second overtone equal to the third harmonic and so on. Rather confusing, isn't it?

However, when applied to crystal oscillators, the terms harmonic and overtone can be even more confusing. An "overtone" crystal vibrates in a different mode to that of a fundamental crystal. The mode is a shearing action which takes place in two planes for the third overtone and in three planes for the fifth overtone. Because of the weird mode, the overtone is not an exact multiple of the fundamental. For this reason, when you order a crystal for overtone operation, you specify the overtone frequency and not the fundamental.

LINEAR MOTORS: Have you ever published any articles dealing with linear motors? I saw one demonstrated on a television program, driving a monorail train and I would like to find out more about it. If you have not published anything along these lines, would you please publish my name and address and ask if anyone could help with this information. (Mr T. C. Shaw, Twiss Street, Latrobe, Tas 7307.)

We have touched on the subject of linear motors in news and feature items but we have not dealt with them in any detail. The articles concerned are not filed as are our projects and we do not have time to conduct a search for this information. However, we have given your name and address and, if anyone can help, they should get in touch directly with Mr Shaw.

10-plus-10 AMPLIFIER: I have recently built the 10-plus-10 amplifier featured in the April 1969 issue. It worked first time but I had to fit a large heatsink to the thyristor as it becomes hot in a short time. Is this normal? The overload protection works well and everything else seems normal. I am using 15 ohm loudspeakers. (S.M., Victoria.)

The fact that your thyristor becomes hot suggests that it has high leakage current and should be replaced. Under normal conditions, when it is off or on, a thyristor dissipates very little power.

REGENERATIVE TUNING STABILITY: A correspondent recently raised the question of stability in regenerative circuits and the reply appeared in the Information Centre in November, 1973. This same subject was discussed in "CQ" for November, 1964 and a number of circuits were given with this article. This added information may be of interest to the original correspondent, along with other readers. (D.S., Palmerston North, NZ.)

Thank you, D.S. for this reference and readers who may be interested may be able to refer to the particular copy of "CQ", in a technical library.

TRANSISTOR LEAD: In recent constructional articles, eg the "130 Receiver", April 1972, a four-lead transistor, type BF115, has been used. None of the articles describe where the "S" lead of this transistor is terminated, nor do the printed circuit boards have a hole drilled to accommodate this lead. Could you please indicate whether the "S" lead is connected to earth, snipped off, or otherwise terminated?

The "shield" or "S" lead of the BF115 transistor, and similar transistor types, is used in critical circuit situations to avoid unwanted RF coupling between the transistor and adjacent circuit components. In these situations, the "S" lead is normally connected to earth.

However, the circuits in which we have used the BF115 are non-critical, and the "S" lead is not used. We usually bend this lead upwards to ensure that it will not short against other components on the printed wiring board. Alternatively, the "S" lead may be snipped off close to the body of the transistor. The first suggested method has the advantage that the transistor may be salvaged for some future project in which the "S" lead is required.

IMPEDANCE PROBLEM: Could you tell me the best way to increase the impedance of a 2 ohm speaker to approximately 8 ohms? As I could not buy a 6 ohm resistor to put in series with it I put three 15 ohm resistors in parallel with each other and in series with the speaker, but this seems to have cut the speaker's output considerably. Will use of a 2 ohm speaker damage an amplifier that specifies 4 to 15 ohm speakers?

Connecting resistors in series with a speaker to provide the required impedance is hardly a preferred method. A major disadvantage is the one you have already experienced — serious loss of output. There are other, more subtle, disadvantages also and the arrangement is really little more than an emergency measure. A better approach is to use an auto transformer to suit the impedance transformation required, but these are not stock items as far as we know, and could be quite expensive.

HOW TO USE OUR INFORMATION SERVICES

As a service to readers "Electronics Australia" is able to offer: (1) Project reprints, metal work dyelines, photographs, printed wiring patterns and other filed material to do with constructional projects and (2). A strictly limited degree of assistance by mail or through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: These cost 80c per issue-reprint. Thus, a project spread over three issues will cost $2.40. Reprints are available for all projects, but no material can be supplied additional to that already published. Reprints can be supplied more speedily if they are positively identified and not accompanied by technical queries. Material not on file can normally be supplied in photostat form at 40c per page.

SUBSCRIPTIONS, BINDERS, HANDBOOKS etc: These are handled by separate departments. For fastest service, send separate orders to the departments concerned.

PHOTOGRAPHS, METAL WORK DRAWINGS: Original photographs are available for most projects, Price: $1 for 6in x 8in glossy print. Metal work dyelines are available for most projects. Price: $1. These show dimensions and positions of holes and cut-outs, but give no wiring details.

PRINTED WIRING PATTERNS: We can supply transparencies, actual size, positive or negative, as specified. Price: 80c. We do NOT deal in manufactured boards. These are available from advertisers.

BACK NUMBERS: As available. On issues up to six months, face value. Seven months to 12 months, face value plus 5c. Thirteen months or older, face value plus 10c. Postage and packing, 30c per issue extra. Please indicate if a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: These are provided to assist readers encountering problems in the construction of our projects published within the last two years. Note, particularly, that we cannot provide lengthy answers, or undertake special research or modifications to basic designs. Charge: 80c. Inclusion of an additional fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee and may be answered in the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "Electronics Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals equipment etc. We are therefore not in a position to comment on any aspect of such equipment.

COMPONENTS: "Electronics Australia" does not deal in electronic components. Prices, specifications, etc should be sought from appropriate advertisers or agents.

REMITTANCES: These must be negotiable in Australia, and should be made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque, endorsed with a suitable limitation.

POSTAGE & PACKING: All charges shown include postage and packing, unless otherwise specified.

ADDRESS: All requests for data and information should be directed to the Assistant Editor, "Electronics Australia", Box 157, Beaconsfield 2014.

ELECTRIC CAR FAN

Latest model electric car fan, which plugs into the cigarette lighter on your car; has 4" blades. The base acts as a suction cap to fix it to your dash; also bracket for mounting on wooden base. Available for 6 volt and 12 volt cars. Specify the voltage required when ordering.

Packed and posted $4.75. Complete with wire & plug.

Order now, limited stocks.

4-SPEED RECORD UNIT

"Ambassador" 4 speed 16, 33, 45 & 78 rpm stereo phono unit, complete with Ronette pickup. Stereo ceramic cartridge and stylus for LP and 78 records.
Packed ready to mount with screws and template for installation..

Instructions for connecting to amplifier or radiogram. 240V AC mains operated.

Posted NSW $16.50. Posted Interstate $17.00.

Reduced from $25.00. Special Offer.

Order now, limited stocks.

NEW RH (Radio House) RANGE OF MULTIMETERS

MODEL RH-60 $29.00 Packing & Postage $1.00

50,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.
Specifications:
DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 25uA, 5mA, 50mA, 500mA
Resistance: 10K, 100K, 1M, 10M.
Decibels: –10 +62dB.
Accuracy: DC ±3 p.c., AC ±4 p.c. (of full scale).
Batteries: Two 1.5V dry cells. Overload protected.

"HANDYMAN" RH150 $14.75

CHECKED PACKED & POSTED $15.50
Pocket-size 3¼" x 4½" x 1¼". Instruction sheet and circuit.

SPECIFICATIONS:
DC Volts: 2.5, 10, 50, 250, 1000. 10,000 ohms per volt
AC Volts: 10, 50, 250, 500, 1000.
DC Current: .1, 25, 250mA.
Resistance: 20K and 2M.
Decibels: –20dB, +62dB, 0.7KHz.
Capacitance: .0001, 01, .0025, 25uF

NEW MODEL NA – 100 CASSETTE CONVERTER

PRICE: **$35.00** Pack & Post $1.00.
Play your cassette tapes through your car Radio and speaker and save **$30.00** to **$40.00**
SIZE 6" x 4½" x 2⅛"
Complete with fittings and instructions to install in any car which has a radio fitted. Radio can also be operated when required. This model reproduces the excellence of music from a cassette through the AM Car radio. Operation is extremely simple.

WORLD RANGE SOLID STATE DELUXE RADIO "LONGINES SYMPNONETTE"

19 TRANSISTORS – 9 Diodes – 500 MW output.
SIZE 11" x 13" x 5"

FEATURES:–
1. Tuning knob
2. Fine tuning knob
3. On-Off push Switch
4. Volume Control
5. Tone Control
6. Squelch Control
7. Band selector knob
8. Time zone
9. Telescopic antenna
10. Dial light
11. AC / DC selector
12. Extension Antenna Jack
13. Earphone Jack

This new Solid State Radio is all-band, all transistor portable designed for super sensitive reception of Amplitude Modulation (AM) Marine Band (MB) International Short Wave (SW1, SW2) Frequency Modulation (FM) Public Service Band LOW (PB), AIRCRAFT (VHF1) High Public Service Band (VHF2) and Weather Band (WB).
These Bands will provide you with many hours of entertainment and excitement. This radio is also equipped for house electricity (240 AC) as well as by batteries (4 "D" cells).
PRICE:– **$135.00** pack & post $1.50.

RADIO HOUSE PTY. LTD.

306-308 PITT STREET 61-3832 26-2817 760 GEORGE STREET SYDNEY. 211-0171

INFORMATION CENTRE

As to whether a 2 ohm speaker will damage an amplifier designed for higher impedances; well, that depends. Older, valve, amplifiers could take this kind of mismatch in their stride, the only disadvantage being a slight rise in distortion. Solid state amplifiers are not nearly so tolerant, and could easily be damaged. If in doubt, don't.

MINI-FI IC: Compliments on your fine magazine which I think caters quite evenly for most aspects of radio and electronics. Could you tell me where I can obtain the IC used in the Mini-Fi (Jan 1974)? Also I have had difficulty in obtaining some plug-in coils made in England by "Denco". These are known as "green miniature plug in coils, ranges 2, 3, 4 and 5" and "Denco RFC5 radio frequency chokes". (C.T., Croydon, Vic.)

Thank you for your compliments, C.T. The Motorola MFC4000B integrated circuit was in short supply, but should be available again from the regular component suppliers from the middle of March, 1974. We regret that we are unable to advise of any suppliers of "Denco" coils.

Elementary from p69

components to be accommodated on our piece of Veroboard, the project is simple to construct and presents no problems. The component layout is illustrated. It should be noted that it is necessary to cut the input/output copper strip at the point indicated in order to maintain the correct circuit and to mount all the components on the one board.

This cut is most easily made with a small (1/8 or 3/16in) twist drill. Simply insert the drill in the hole and turn with the fingers. This will cut into the hole, removing the copper. Ensure there is a clean and absolute break, with no copper left straddling either the hole or adjoining tracks.

When it has been built and the equipment set up for test, don't be surprised if the whole thing screams its head off as soon as the volume control is advanced. This will be due to acoustic feedback caused by the microphone picking up signals from the speaker and feeding them back into the system. This is quite normal, and it is best to place the microphone as far away from the speaker as possible.

Books from p96

conical antennas, together with measured data for various conical scatterers in the resonance region. The theory of each structure is summarised, and there is an extensive and up-to-date bibliography.

A book which should be of considerable value to those designing specialised aerial systems. The review copy came direct from the London office of the publisher, and no information was given regarding local price and availability. (J.R.)

NOTES & ERRATA

DIGITAL FREQUENCY COUNTER (December 1973, File No 7/F/18): The circuit diagram on page 42-3 should show the coupling capacitor between the 2N3563 and IC2 as a 47uF unit, with the polarity as shown in the wiring board diagram of page 41. Similarly the circuit should show the input clipping diodes on the prescaler as being returned to the 5V line, not to earth, although this does not affect operation.

Marketplace

FOR SALE

COMPUTER BOARDS c w edge connectors $1.00. 30 pin plugs & sockets $1.00. IC's 7400, 7404 65c; 7490 $1.60. Min relays 2 co, 4co with bases $1.00. NE555 $2.00. P & P 20c all items. Burnlee Trading, PO Langwarrin, 3910.

DESOLDERING BRAID, In bulk quantities, less than ½ normal price, 25c per yard. Minimum order 2 yards, Lethean, PO Box 239, Ringwood, Victoria. Trade also.

BRAND NEW TRANSFORMERS. 14 volt 3 amps, limited supply, $3.50 each. 27 volt 7 amps $4.00 each. Postage paid if within NSW. Send cheque or money order to: Carl's Electronics, 2/27 Forsyth Street, Kingsford, NSW 2032.

ADVANCE Sine/square wave oscillator 25Hz-50kHz, fitted 1½in VU meter, low distortion, perf. cond. $39.00. Watson, 9 35 Walsh St, Sth Yarra, 3141, Vic. Tel. 266484.

COLOUR TELEVISION degaussing coils. Demagnetise TV receivers, metal, etc. 240V AC, 1200 amp. turns, 12in dia. Complete, $37.00 including pack & post. J. R. O'Shea, PO Box 434, Liverpool, 2170.

MARKA-SWEEP generator model RF-P Kay Electric, USA. 12 channel + IF each xtal controlled aligned by AWA Wobbulator CRO German Wobbelmessplatz 203 matched for sweeper, $150 ONO. Tel. Sydney 39 5637.

CRYSTALS XTAL 27 240, 26 785, ¼ inch pins $6.00 per pair post free. P. Shalley, 127 York St., Sydney 2001.

TV REPAIR BUSINESS Gold Coast. Long est., great potential. 3br bv home, pool. Select area, $65,000. E. Nunn, PO Box 558, Southport, Qld.

BUYER REPRESENTATIVE & MAIL ORDER: JFET, transistors, diodes, rectifiers, capacitors, radio parts, TR radio kits etc. prompt delivery. Write for free catalogue to: Radio Electronic Instrument Co., Chesterfield Mansion, 8th fl., Flat C, Kingston Street, Causeway Bay, Hong Kong.

UNIVERSITY OSC. 530kHz to 30MHz. Palec VTVM and VCT. Offers Syd. 39 7131.

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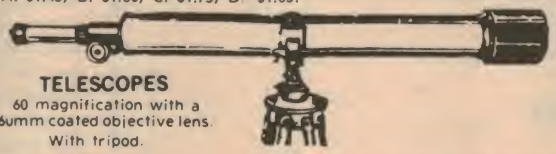

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People who play the waiting game have just won.

If you've been patiently waiting for something special in audio equipment, congratulations.

Because you can now choose from TEAC's newly introduced triple-header.

First, a 4-channel deck with 2-channel automatic reverse playback.

Second, a unique 4-channel Dolby* Noise Reduction Unit.

Finally, a stereo cassette deck that equally competes with reel-to-reel decks selling for much more.

TEAC's A-2340R lets you record as well as listen to the new, surrounding sounds of 4-channel. And you also have the convenience of enjoying both sides of 2-channel tapes without having to change over half-way through.

The perfect partner for this deck is our 4-channel Dolby unit. The AN-300. It eliminates tape noise and hiss that can interfere with the music.

Legally we can't call our A-450 cassette a reel-to-reel deck. But listen once and you'd find it hard to tell the difference.

We've perfected it to the point of keeping wow and flutter below 0.07%. No, that's not a misprint. We did say 0.07%.

And as if that wasn't enough, it even has a built-in Dolby System.

Those are the three sound reasons why you've just won the waiting game.

See, sometimes it really pays to wait after all.

TEAC
The sound of perfection

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